A CBO STUDY

# Public Works Infrastructure: Policy Considerations for the 1980s

April 1983

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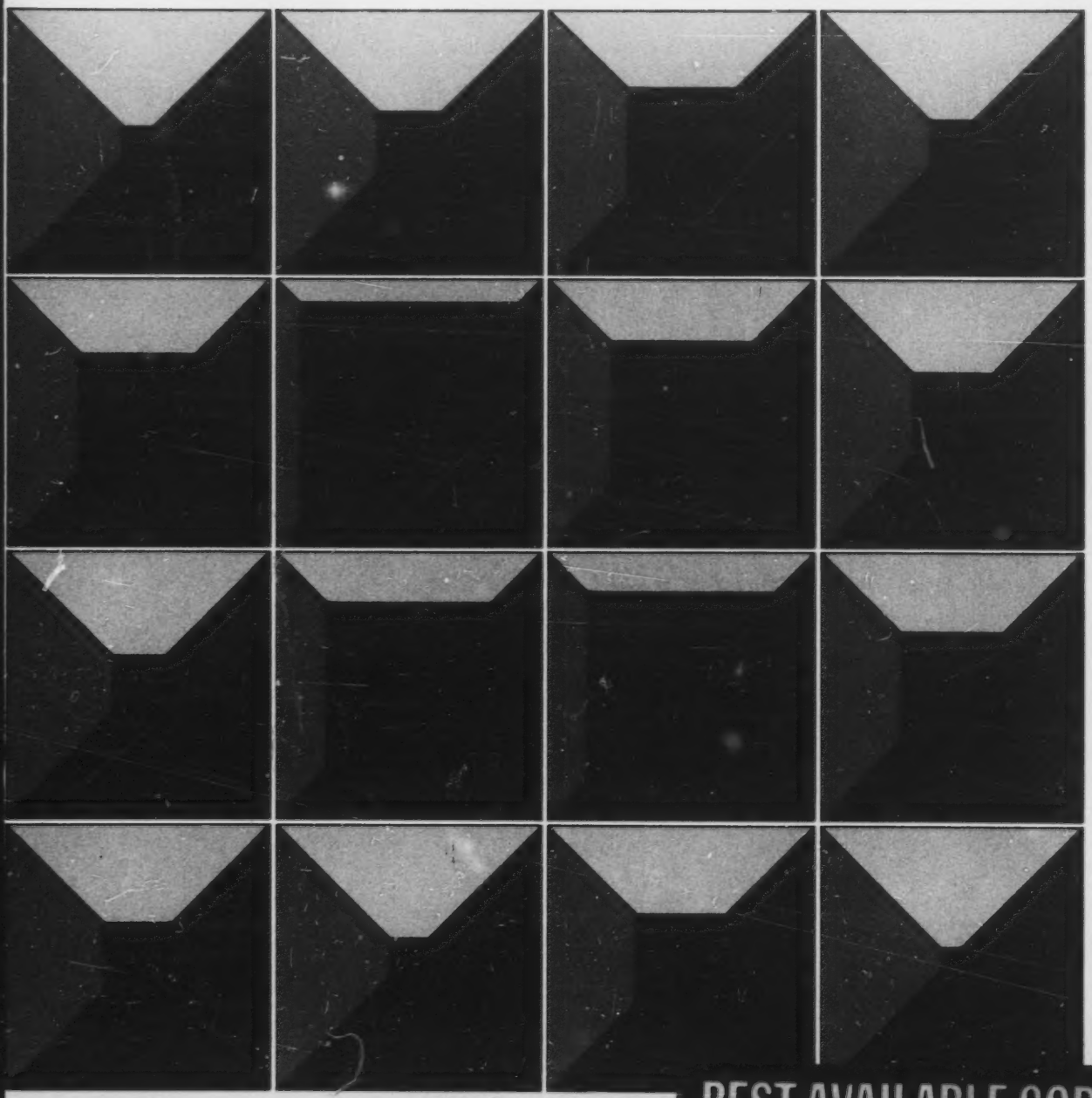

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# PUBLIC WORKS INFRASTRUCTURE: POLICY CONSIDERATIONS FOR THE 1980s

Congress of the United States
Congressional Budget Office

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*NOTES*

*At the start of Chapters II through VIII, each of which deals with a single infrastructure system, a brief paragraph summarizes the problems affecting that system and the associated costs, the federal government's current and possibly altered participation, and the application of several policy strategies.*

*Unless otherwise noted, all dollar figures are expressed in constant 1982 dollars. All dates are fiscal years unless specified as calendar years.*

*In some tables, details may not add to totals because of rounding.*

## PREFACE

The nation's long-term economic growth will depend heavily on the adequacy of its public works infrastructure. In the past several years, much attention--both public and Congressional--has been drawn to the declining condition of infrastructure systems and to those systems' capacity to accommodate future economic and population growth. This study, undertaken at the request of the Senate Committee on the Budget, assesses the needs of seven infrastructure systems and the costs of meeting those needs. The primary focus of the analysis is on the cost effectiveness of infrastructure investment, a concern made particularly pressing by the constraints now affecting the federal budget. In this context, the paper considers how current federal policies and funding levels may or may not mesh with infrastructure needs anticipated over the coming decade, how possible policy changes might bring about improved cost effectiveness, and how changes at the federal level could affect state and local governments and the private-sector beneficiaries of infrastructure services.

The study was prepared by David L. Lewis, Richard R. Mudge, Kenneth Rubin, and Suzanne Schneider of CBO's Natural Resources and Commerce Division under the supervision of David L. Bodde. Johanna Zacharias assisted in drafting and edited the manuscript. The authors owe special thanks to Angela Z. McCollough and Kathryn Quattrone for their skill and diligence in typing the many drafts and preparing the paper for publication. Many people offered valuable comments on drafts, particularly Everett M. Ehrlich, Debra F. Goldberg, Robert W. Hartman, Anne E. Hoffman, Daniel Koretz, Kathleen Kelly, Patrick J. McCann, Pearl Richardson, and Robert Sunshine of CBO, and G. William Hoagland and other members of the Senate Budget Committee staff. Graphic illustrations were prepared by Andy Hemstreet. In keeping with CBO's mandate to provide objective analysis, the study offers no recommendations.

Alice M. Rivlin
Director

April 1983

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*(A precis appears on the opening page of Chapters II through VIII.)*


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## CHAPTER I. CONSIDERING PUBLIC WORKS INVESTMENT --FRAMEWORK AND OVERVIEW

The nation's public works infrastructure--defined here as including highways, public transit systems, wastewater treatment works, water resources, air traffic control, airports, and municipal water supply--is suffering from growing problems of deterioration, technological obsolescence, and insufficient capacity to serve future growth. 1/ The nature, extent, and severity of these problems vary widely among the systems considered. But attention on them has converged at a time when tight budgetary constraints are forcing the federal government, the states, and the localities to review spending priorities and to make difficult decisions about what they can and cannot undertake.

At the federal level, capital spending for public works is projected to average more than $24 billion a year between 1983 and 1990 (see Table I-1). 2/ If current programs are maintained without change, these outlays would fall somewhat short of meeting needs as they are defined by the agencies with a role in providing these services. 3/ Meeting needs under federal programs as they are now structured would raise annual federal spending to about $28 billion--or more, if needs are interpreted as reflecting a broader federal responsibility. At the same time, however, federal policies could be altered in a way that could bring the total federal costs to a lower level than under current programs--albeit with important

---

1. The concept of infrastructure can be applied broadly to include such social facilities as schools, hospitals, and prisons, and it often includes industrial capacity as well. The seven systems considered in this study share the common characteristics of capital intensiveness and high public investment at all levels of government. They are, moreover, directly critical to activity in the nation's economy.

2. Unless otherwise noted, all dollar figures cited in this study are expressed in 1982 dollars.

3. Needs are inherently difficult to quantify. They can depend on levels and quality of services, valuations of time, health, and safety, and other concerns. The composition of needs estimates is described in each chapter.

TABLE I-1. FEDERAL SHARE OF ANNUAL CAPITAL INFRASTRUCTURE COSTS UNDER CURRENT AND REVISED POLICIES, 1983-1990 (In billions of dollars)

| Infrastructure System | Current Spending Level | Annual Spending to Meet Alternative Measures of Need | |
|---|---|---|---|
| | | Under Current Program Structure | Under Revised Programs |
| Highways | 12.7 | 13.1 | 9.3 |
| Public Transit | 3.7 | 4.1 | 2.2 |
| Wastewater Treatment | 3.2 | 4.2 | 3.7 |
| Water Resources | 2.3 | 3.7 | 3.1 |
| Air Traffic Control | 0.8 | 0.8 | 0.7 |
| Airports | 0.8 | 0.9 | 0.3 |
| Municipal Water Supply | 0.9 | 1.4 | 1.0 |
| Total | 24.4 | 28.2 | 20.3 |

SOURCE: Congressional Budget Office.

implications for the states and localities that participate in providing public works and for the private-sector beneficiaries of infrastructure services.

The structure of many current federal programs tends not to encourage selection of the most efficient projects. Many also channel federal money toward projects that are of greater local interest than of overall nationwide benefit. Further, many federal programs were designed for important goals that have now been met--building a national network of highways, for example, or fostering regional development of agriculture, or constructing a system of locks and dams. Today, however, the more pressing needs are maintenance and repair.

Revised programs that emphasized investments with clear national significance and that reduced the current bias toward capital-intensive undertakings could improve the cost effectiveness of federal spending. One mechanism to help guide cost-effective investment is increased use of user fees, which can either raise money for needed projects or dampen demand, in turn diminishing needs. Under policies redesigned to reflect these considerations, federal costs to meet the nation's infrastructure needs could in fact be reduced to about $20 billion a year--$4 billion less than current spending.

Though such changes could bring about more cost-effective investments and with them, reduced federal spending, they might have to be coupled with other major nonfederal changes. State and local commitments to public works spending might have to rise. Users of services might have to pay more than they do now. And the levels of service now available might have to be diminished.

## THE DIVERGENCE OF NEEDS AND POLICIES

Policies of planned governmental subsidization evolved out of concerns for regional development and fairness dating back to the early days of the nation's expansion and settlement. The aim of accelerated development of the West at the turn of the century, for example, prompted the federal government to foster western agriculture by subsidizing irrigation systems. Assistance to needy regions and groups of people has been another motive underlying federal subsidies to infrastructure services. Examples include the Appalachian highway program and much of federal aid to urban mass transit systems. Most federal infrastructure programs, having evolved without a single direction and having been shaped over time by the need to establish an infrastructure foundation, fail to recognize today's highest priorities--repair, rehabilitation, and replacement. Thus, the orientation of current federal infrastructure policies can promote inefficient spending.

Many of the concerns that once motivated subsidies for infrastructure facilities may now no longer apply. And in some instances, continuation of these policies can distort economic choices. Freight shipping on inland waterways, for example, has become a mature business, suggesting that the need for nurturing, in the form of federal subsidies, may long since have been met. In fact, these subsidies now cover more than one-fourth of the costs of the barge industry, many times the share of federal subsidies for other modes of transport. As an example of economic distortion, federally subsidized water transport encourages the use of barges rather than railroads, and this in turn stimulates demand to build more locks and dams with federal dollars.

## ISSUES BEFORE THE CONGRESS

The Congress faces difficult choices about how to solve the nation's infrastructure problems: whether simply to change funding levels while keeping the present structure of federal programs intact, or to make more fundamental changes in the process by which these investments are made. In this context, the Congress confronts three fundamental questions:

- **How should the costs of future infrastructure spending be divided** among the various participants--the federal, state, and local governments and the users of infrastructure services?
- **What areas of infrastructure spending are the federal government's province,** as defined by the interests of the nation as a whole? and
- **How can federal policies encourage the selection of cost-effective projects** in general, including an appropriate balance in investments between new construction and maintenance?

## PLAN OF THE STUDY

The remainder of this chapter gives an overview of the nation's present infrastructure problems and of the federal role in dealing with them. It begins with a review of the economic purpose of public works investment. Then, drawing on the analysis in the remainder of the paper, it assesses the extent and nature of infrastructure problems, the potential costs to the nation of neglecting these problems, and the potential effects of relying on the federal programs now in place for remedies. This overview closes by outlining three possible strategic approaches that, applied in varying combinations, could help promote effective public works investment.

Although the seven infrastructure systems considered here share some basic characteristics, the diversity among them limits generalization. Therefore, each chapter examines one system only, briefly recapitulating the current problems of that system and estimating the costs of correcting those problems. Then, in an attempt to define means for achieving more cost-effective investments, each chapter explores various funding and spending strategies. Chapter II deals with highways, Chapter III with public transit. Chapter IV concerns wastewater treatment; water resource investments--dams, ports, inland waterways, and the like--are addressed in Chapter V. Chapter VI deals with air traffic control, Chapter VII with airports, and finally, Chapter VIII addresses municipal water supply. The sequence of chapters roughly reflects the size, in descending order, of the current federal role in financing these diverse infrastructure services.

## THE ECONOMIC OBJECTIVE OF INFRASTRUCTURE INVESTMENT

Federal, state, and local governments participate in providing public works primarily for two purposes: to achieve an efficient use of resources, and to assure an equitable distribution of services. These goals might not always be met if provision of services were left solely to the marketplace. In evaluating the economic consequences of contemplated road construction, for example, a governmental body considers potential time savings, productivity improvements, industrial development, and safety; a private firm, in contrast, might give highest priority to the direct revenues that would accrue from road users. Thus, private enterprise would find fewer instances in which the benefits of road construction outweighed the costs, and as a result, fewer roads would be built than might actually be desirable for the well-being of the economy as a whole.

### The Federal Role

In making infrastructure investments, each level of government has its own unique role to play. State or local governments subsidize facilities that serve their own residents, but they do not always have incentives to make investments that also serve the best interests of the economy at large. The federal government is in the best position to ensure that infrastructure investments simultaneously advance national goals of efficiency and fairness. Over the years, federal involvement in the provision of public works has grown in response to several specific concerns:

- **Underdeveloped regions.** States in less developed regions may lack the resources to finance the construction of infrastructure projects needed for regional development.

- **External costs and benefits.** Individual states may lack the incentives to supply certain facilities and services in sufficient quantity, since the costs and benefits of some public works cross state borders.

- **Centralized planning.** Some infrastructure services are provided most effectively when coordinated by central administrative bodies.

- **Inequities and hardship.** Some population groups, such as the poor and the handicapped, may need federal intervention to assure their access to certain public services.

Understanding whether current federal programs respond to these concerns in a cost-effective manner requires analysis of the nation's infrastructure needs and how federal investment practices do and do not mesh with them.

## THE NATURE OF CURRENT INFRASTRUCTURE PROBLEMS

A hundred years in the making, the United States' public works infrastructure is now largely in place, providing the physical framework for continued expansion, population shifts, and economic growth. The nation's capital spending has not kept pace with increases either in economic activity or population, however. In 1960, estimated capital outlays by all levels of government for the seven infrastructure systems considered in this study were about 2.2 percent of Gross National Product (GNP). By contrast, 1980 capital spending was 1.3 percent of GNP. In terms of population, infrastructure investment fell from $187 per capita in 1960 to $174 per capita in 1980.

As a result, physical problems of adequacy have been mounting. Many highways, bridges, water systems, transit systems, and other public works have deteriorated. Other systems have become technologically obsolete. In certain areas, infrastructure capacity is insufficient to serve projected population growth. Though the extent and severity of these problems vary markedly among the seven public works systems examined here, some generalizations can be made.

### Deterioration and Obsolescence of Existing Facilities

The most pervasive problem affecting the nation's infrastructure is physical deterioration resulting in mounting needs for repair, rehabilitation, and replacement. Many components of infrastructure systems show the effects of aging, and some are approaching the end of the "design lives" planned by their engineers and builders. Aging problems are compounded by the cumulative effects of inadequate maintenance and repair.

No area of infrastructure has been wholly unaffected by aging and neglect. For example, most of the nation's highway network shows significant signs of deterioration. Approximately 8 percent of Interstate highway mileage is now classified as "poor," indicating that it is badly deteriorated and in need of resurfacing or rebuilding. Another 34 percent is in "fair" condition and may be only barely adequate for high-speed traffic. Similarly, the treatment and distribution components of many urban water supply systems are nearing the end of their useful lives; leakage losses of up to 40 percent are not uncommon in the Northeast, where some water mains

have been in service for a century or longer. In the nation's inland waterway system, some locks are approaching 80 years of service--30 years beyond the generally accepted limit for safe, efficient operation. And in the area of air traffic control, existing equipment has been outmoded by the development of new, more efficient microchip technology.

### Insufficient Capacity for Growth

Though less widespread than deterioration, insufficient capacity to serve projected growth is a problem in some areas. In Houston, for example, economic development and a rapidly expanding population have brought increased vehicular traffic, which clogs local roads not designed to handle such volume. Similarly, communities in which existing wastewater treatment plants operate at full capacity will not be able to support new industrial or residential development without expanding their sewage treatment capacities. In addition, deepening several of the nation's major ports may be necessary in coming years to accommodate the larger "world class" coal-carrying vessels to permit continued growth of U.S. coal exports. Finally, substantial future increases in aviation activity could create a need to expand existing airports if severe congestion is to be avoided.

## POTENTIAL COSTS OF NEGLECT

The costs of neglecting these infrastructure problems can be substantial, although comprehensive and precise estimates cannot be made. These include higher long-term construction and repair costs for facilities that are not properly maintained, higher costs borne by users of inadequate facilities, and potential constraints on economic development.

Unchecked deterioration of infrastructure facilities can cause total construction and repair costs to rise over the lifespan of a facility. For example, in regions where salt is used to melt snow, failure to keep bridge deck pavement in good condition can have serious--and very expensive--consequences, as worn pavement allows salt to leak through and corrode the bridges' steel underpinnings. Deferred maintenance on water delivery pipes can lead to buildups of deposits inside pipes, and eventually, flow can become so restricted that the pipes must be replaced.

Users of inadequate infrastructure facilities also bear significant costs. Every time a bridge is closed to traffic or subjected to weight restrictions because of deterioration, users' time and money are lost. In the worst cases, there may also be substantially increased safety risks. Airport delays, mostly occasioned by congestion at large commercial airports, cost

the airlines roughly $1 billion in 1980, wasted some 700 million gallons of fuel, and resulted in 60 million hours of waiting time for airline passengers. Similarly, deterioration of pavement on the nation's highways results in substantial increases in vehicle operating costs. For example, operating costs for a small automobile are almost one-third higher on poor roads than they are on well-maintained roads.

Deterioration of existing facilities and insufficient capacity to accommodate future growth can eventually constrain economic development. The nation's transportation network, water supply, and wastewater treatment facilities provide vital services for both industries and individuals; where capacity is inadequate to meet the needs of growth, that growth can be stunted. Similarly, a community with badly deteriorated roads, bridges, or other transportation facilities is in a weak position to attract new businesses. Though more difficult to quantify than the costs of deferred maintenance, these costs are no less real.

## THE COSTS OF CORRECTING INFRASTRUCTURE PROBLEMS

Like estimates of the extent and severity of the nation's infrastructure problems, estimates of the costs of correcting those problems are necessarily imprecise. To some extent, this reflects a lack of aggregate data and differences about what the definition of infrastructure includes. Overestimates may at times reflect the interests of affected parties. In addition, the orientation of current programs toward new construction tends to lead to overstated estimates of need. But most important, the costs of remedying these problems depend on the extent and quality of the infrastructure services the nation wishes to purchase. As a result of these uncertainties, estimates of the costs of meeting the nation's infrastructure needs range widely.

Nevertheless, quantitative estimates are possible, though the evidence they derive from may differ qualitatively. Under current policies, the CBO estimates that annual capital outlays by all levels of government would have to increase from $36 billion to roughly $53 billion between 1983 and 1990 to remedy problems in the infrastructure systems considered here (see Table I-2). Part of this increase, roughly $6 billion a year, is already assured by the new tax on motor fuel enacted by the 97th Congress. Beyond that, however, increases both in federal and in state and local spending would be required to meet the infrastructure investment needs as current policies define them.

More important than the aggregate level of need, however, is the emphasis that current policies place on new construction. Annual invest-

TABLE I-2. ESTIMATED ANNUAL CAPITAL NEEDS FOR SELECTED INFRASTRUCTURE PROGRAMS UNDER CURRENT POLICY, 1983-1990 (In billions of 1982 dollars)

| Infrastructure System | Annual Capital Spending | | | Effective Federal Share of Total |
|---|---|---|---|---|
| | Total | New Construction | Repair, Rehabilitation, and Replacement | |
| Highways | 27.2 | 9.9 | 17.3 | 13.1 |
| Public Transit | 5.5 | 2.2 | 3.3 | 4.1 |
| Wastewater Treatment | 6.6 | 6.1 | 0.5 | 4.2 |
| Water Resources | 4.1 | 2.3 | 1.8 | 3.7 |
| Air Traffic Control | 0.8 | 0.1 | 0.7 | 0.8 |
| Airports | 1.5 | 1.0 | 0.5 | 0.9 |
| Municipal Water Supply | 7.7 | 3.6 | 4.1 | 1.4 |
| Total | 53.4 | 25.2 | 28.2 | 28.2 |

SOURCE: Congressional Budget Office.

ment to meet needs as they are defined under current policies would be split roughly evenly between two categories: repair, rehabilitation, and replacement of existing structures; and entirely new construction to meet growing demand (shown in Table I-2). Two infrastructure systems appear dominated by a demand for new construction--wastewater treatment (93 percent new construction) and airports (67 percent), while new construction represents roughly half of overall projected spending through 1990. The large role that new construction plays in the apparent demand for infrastructure spending reflects the orientation of current policies, rather than the priority of need.

## FEDERAL INVESTMENT AND ECONOMIC EFFICIENCY

The tight constraints now affecting the federal budget--CBO is now projecting a federal deficit of $201 billion in 1984--give particular urgency to the efficiency with which infrastructure dollars are spent; concern with such efficiency tends to grow in importance relative to other policy objectives as budgetary pressures constrain available resources. In a time of intense budgetary stringency, when the wishes of all sectors cannot be accommodated, decisionmakers face difficult choices: Should the federal government complete the still-unbuilt segments of the Interstate Highway System, or should it repair aging sections of existing Interstates and leave some segments unbuilt? Should the federal government extend East Coast port facilities to accommodate deep-draft ships? Does the nation need a new air traffic control system now, or can modernization wait? Economic efficiency, measured by weighing costs against benefits, points to answers to such questions. Against this yardstick, the investment conferring the greatest economic value (which can be measured by what users are willing to pay for) relative to that investment's cost would be given highest priority.

Three features shared in some degree by most federal infrastructure programs underlie problems in the cost effectiveness of current public works spending:

- **Undercharges to users.** The direct beneficiaries of infrastructure services often pay fees that recover less than the cost of providing those services, thus leading to excessive demand for infrastructure services. This in turn can lead to overestimates of investment needs.

- **Failure to differentiate federal and nonfederal needs.** The eligibility of projects for federal funds often extends to projects of primarily local significance, thus diverting funds from investments of national importance and allowing federal funding decisions to influence the pattern of state and local investment.

- **Bias toward capital-intensive projects.** Cost sharing in federal programs tends to direct funds to capital uses only and to pay a very high share of these, thus causing a bias toward capital-intensive projects regardless of the merits of alternative approaches.

This section assesses the inefficiencies these federal investment practices can cause in light of shifting infrastructure priorities.

Undercharges to Users

Though users of many of the nation's infrastructure facilities pay some sort of fees under current policies, most user fees are set well below levels that would recover all the federal government's costs. In effect, these differences are financed by federal subsidies, and thus they are supported by the general taxpayer. In only two of the seven programs considered here--highways and airports--are fees now high enough to defray all federal costs. And even in these two programs, some users--notably, operators of heavy trucks and private planes--pay less than their share of federal outlays, while other users--light truck operators and airline passengers--make up the difference by paying fees that recover more than their share of costs.

By stimulating demand, subsidies can lead to exaggerated perceptions of infrastructure expansion needs. Overstated demand promotes unneeded new construction--often done instead of needed repairs--and thereby diminishes efficiency in the allocation of scarce public investment capital. Fees that do not fully recover the cost of a certain service can result in localized demand by regions or user groups for services that may not benefit the economy at large.

Where regional economies have matured and subsidized development is no longer needed, perpetuation of below-cost user fees has led to economic distortions. The effects of federal subsidies to inland navigation are a case in point. Similarly, federal water subsidies for Western irrigation have induced many farmers to grow water-intensive crops such as rice or cotton sometimes in competition with farmers in other regions.

In other instances, subsidies have been less effective in reducing external costs than the decisionmakers who initiated them once hoped. For example, the evidence available suggests that reductions in public transit fares in urban areas have little effect on road traffic, even though the purpose of the transit subsidies required to lower fares includes reductions in auto congestion and air pollution. Hence, the decongestion and environmental benefits of transit subsidies may be small compared with their costs.

Also, subsidies designed to alleviate personal hardship do not always benefit the people who most need the help. For example, household expenditure on mass transit, which the federal government subsidizes heavily, is concentrated in the upper-income groups. Households in the top one-third of the nation's income distribution receive more than twice as

much in operating subsidies as do the poorest one-quarter. 3/ Thus, the subsidy for urban transit tends to shift income to high-income households. 4/ There are, however, many cases in which the subsidies for infrastructure services are both relevant and effective; market forces alone undervalue these services. Subsidies targeted to specified groups, such as wheelchair users, can prove effective in alleviating those individuals' travel problems.

## Federal Priorities and Nonfederal Needs

A key feature of most federal infrastructure programs is their dual focus on national and local projects. Access to federal money extends not only to major national investment projects, such as Interstate highways, but also to locally oriented projects, such as water supply facilities and farm-to-market roads. Federal involvement in local projects can at times promote economic efficiency and improve equitable distribution of resources over what states alone might achieve. For example, a state might build a wastewater treatment plant that is well suited to its own needs but that discharges pollutants down-river to neighboring states; in such a case, the neighboring state stands to bear costs. By funding wastewater treatment, the federal government encourages states to build sufficient capacity to prevent harmful spillovers, and thereby reduces overall wastewater costs to the economy. In other cases, coordinated planning of locally oriented infrastructure services may also improve economic efficiency and help ensure the widespread distribution of associated public benefits. For example, in the early days of aviation, local governments operated their own air traffic control towers. Today, the federal government equips and operates the towers, thereby reducing system-wide administrative costs and overhead and ensuring safe air travel.

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3. See, for example, John Pucher, "Who Benefits from Transit? Recent Evidence from Six Metropolitan Areas," in Transportation Research, Vol. 17A, No. 1 (January 1983).

4. A similar pattern of income redistribution has been attributed to federal subsidies for intercity rail passenger service, analyzed in detail in Congressional Budget Office, Federal Subsidies for Rail Passenger Service: An Assessment of Amtrak (July 1982). Rail freight service is not analyzed in this paper because deregulation has provided the means for most railroads to finance their own investments, and government aid is being phased out. Rail passenger service carries only about 0.3 percent of all intercity passenger travel and thus does not play a major part in the nation's economy.

But when no rationale exists for national involvement in local projects, federal funding can distort economic choices by diverting federal funds from more pressing national needs. As an example, the financial advantages to states through 90 percent federal matching shares for Interstate highway construction encourage states to build many highway projects that the nation as a whole does not need. This can divert federal resources that could otherwise be used to repair key national routes.

Federal subsidies can also produce distortions with purely nonfederal consequences. To the extent that states and localities fund their own projects, they have an incentive to assure that only economic investments are made; to whatever degree the federal government shares the costs, that incentive may be blunted. At one time, federal investments in many locally oriented public works were needed to help local governments amass sufficient capital to pay the large initial costs. This need is less acute today. Various nonfederal financing mechanisms are now available to draw together the resources for infrastructure investment, and many of these are especially well suited for application on the state and local level. Indeed, many states and localities are already exploring such options with notable resourcefulness. A good example is New Jersey, which has recently proposed a state infrastructure bank to provide a revolving loan fund for local construction and improvement projects. State and local financing mechanisms are extensive and varied, and they include earmarked revenue sources including local user fees, state bond guarantees, flexible instruments to improve access to credit markets, and lease-purchase arrangements. With these emerging financial sources, states and localities may no longer require substantial federal aid to finance large up-front capital costs. Many community airports, for example, which still draw 90 percent federal grants for capital improvements, are now rated in the municipal bond market as premium investments and might easily finance their own capital development without federal aid.

## Bias Toward Capital-Intensive Projects

Over the years, most federal infrastructure programs have offered high matching grants to states and localities for new construction and replacement, while providing relatively few incentives for the rehabilitation and maintenance of existing facilities. This federal emphasis derives from two factors: the special financial difficulties imposed by the high capital requirements of major infrastructure projects, and the reluctance of states to shoulder these burdens when so many of the benefits accrue to out-of-state residents and businesses. Indeed, the high share of costs assumed by the federal government has at times proven most effective in stimulating investment. For example, while the federal share of Interstate highway



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financing was still relatively low (50 percent), progress in building the network was slow. But construction increased quickly when the federal share rose (to 90 percent in 1956), and by 1980, the 42,944-mile system was nearly complete.

Today, with the nation's infrastructure systems largely built, a continued emphasis on new construction and replacement can induce states and localities to neglect needed repairs. Although documentation of this practice is far from comprehensive, a recent survey of 300 cities reported by the General Accounting Office found that federal grants prompted 90 percent of the cities questioned to shift their resources to seek federal matching capital construction funds, rather than apply their resources to needed infrastructure repairs. 5/

The capital-intensive bias also encourages states and localities to build new infrastructure capacity when more cost-effective investments are possible. For example, the 80 percent federal matching grants available for new transit bus purchases have led many local transit authorities to ignore the economic merits of rehabilitating older buses. 6/ And in a still more extreme example, the 90:10 federal:state financing for new Interstate highway construction gives states an incentive to build new roads without regard even to those roads' local economic merits. A recent analysis indicates that 56 percent of all uncompleted Interstate highway projects are economically unattractive when their total costs are weighed against their benefits. 7/

## FEDERAL STRATEGIES FOR INFRASTRUCTURE INVESTMENT

The CBO has considered three strategies by which the federal government might attempt to correct inefficiencies stemming from current federal policies:

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5. See General Accounting Office, Effective Planning and Budgeting Practices Can Help Arrest the Nation's Deteriorating Public Infrastructure (November 1982).

6. The Surface Transportation Assistance Act of 1982 decreased the match to 75 percent starting in 1983.

7. See Mark Skrotzki, Economics of Completing the Interstate Highway System, reproduced in Congressional Record (December 15, 1982) p. S14841.

- **Adjusting federal user fees** both to produce a reliable measure of national needs and to correct present misalignments among users;
- **Limiting the federal role** to infrastructure investments with clear national importance; and
- **Redirecting existing federal aid** to alter the current bias toward capital-intensive investment decisions.

Applied in combination, though with varying emphasis to reflect program and needs differences, the strategies might improve the efficiency of federal infrastructure investments. Table I-3 summarizes the possible areas of application of the three strategies.

TABLE I-3. APPLICATION OF FEDERAL STRATEGIES TO INFRASTRUCTURE SYSTEMS

| Infrastructure System | Federal User Fees a/ | Limited Federal Role | Redirected Federal Spending |
|---|---|---|---|
| Highways | Yes b/ | Yes | Yes |
| Public Transit | No | Yes | Yes |
| Wastewater Treatment | No b/ | No | Yes |
| Water Resources | Yes b/ | Yes | Yes |
| Air Traffic Control | Yes | No | No |
| Airports | Yes b/ | Yes | No |
| Municipal Water Supply | No b/ | Yes | No |

SOURCE: Congressional Budget Office.

a. Reflects possible adjustments in federal user fees only and does not reflect user fee increases at the state and/or local level.

b. State and local user fees may be applicable in addition to or in lieu of federal user fees.

## Adjusting User Fees

User fees that fully recover the federal government's costs can yield a good gauge of need for infrastructure services. They can result not only in services that are self-financing, but also in a more accurate measure of needs. To the extent that users of services are willing to repay the government for investments made in their behalf, revenues become available to support those projects. But to the extent that higher fees prompt users to reduce demand, investment needs decline. When high fees cause reductions in demand, investments can be tailored accordingly.

Aviation user fees provide a good example of this. At present, these fees are too low to cover the costs of the additional runways and air traffic control services needed to alleviate delay and safety problems during periods of peak demand. If user fees were raised to cover such costs, some traffic would shift to less crowded airports, thereby reducing the need for airport expansion, while users willing to pay the price of extra capacity would provide the necessary revenue through their payment of fees.

User fees that recover full government costs may not be appropriate in all cases, however. For services designed specifically to benefit users and non-users alike (as is the case, for example, with wastewater treatment), full-cost recovery can lead to insufficient capacity. At the same time, increased federal user fees could interfere with state and local governments' ability to impose their own fees; highway taxes are a good example of such possible displacement. In general, however, increased federal fees could play a major role in water resources and air traffic control program developments. In highways, as stated earlier, federal user fees appear to undercharge heavy trucks at the expense of light trucks, even though the overall level of revenues from fees does cover expenses. Increased local fees could be appropriate for airports, municipal water supply, and wastewater treatment. Mass transit, however, offers limited opportunities for cost recovery.

## Limiting the Federal Role

Limiting the federal role could release federal funds for investments that are clearly national in scope. At the same time, a narrowing of the federal role could be done in a way that both encourages localities to assign priorities to their own investment undertakings and that gives them greater latitude in dealing with their own needs. In general, a more restricted federal role could be considered for highways, transit, and airports. Reduced federal funding for local airport facilities, for example, would permit the federal government to channel more funds to modernizing outmoded air

traffic control equipment. Moreover, local responsibility for airport funding could lead states to make more cost-effective investment decisions as they assessed their needs for local airport expansion. The already restricted federal role in municipal water supply could be kept small.

Clearly, though, any move toward a more limited federal role would impose high transition costs on state economies, even if the policy were beneficial in the long run. For example, if the federal government withdrew financial support for deep-water ports, state and local governments, to avoid reductions in service, would need to increase general taxes or specific user fees. Such increases would have to be substantial, and if imposed suddenly, they could result in local economic dislocation. To avoid such shocks, the federal government could reduce its role gradually. In highways and airports, for example, the federal government could follow an interim policy of turning back user fee revenues to allow states and localities to phase in their own higher taxes.

In addition, the federal government might continue to provide some local infrastructure services because of its cost advantage (as in most water resources), or because state and local governments, acting alone, have weak incentives to provide adequate facilities (as in wastewater treatment).

## Redirecting Federal Assistance

Though the first two strategies would reduce total federal capital spending for public works infrastructure, this approach would promote more effective use of the remaining funds and reduce possible capital biases in investment decisions. It could be most usefully applied to infrastructure programs in highways, wastewater treatment, water resources, and mass transit. It could include three major modifications to current policies: changing the definition of what federal funds can be used for, reducing the federal matches on capital grants, and replacing rigid federal regulations with more flexible cost-sharing arrangements.

These changes might encourage state authorities to broaden the range of alternatives to new infrastructure construction they consider. More flexible cost-sharing terms and reduced federal matching ratios would induce states and localities to allocate federal funds among new construction, rehabilitation, and repair according to their own priorities. For example, requiring localities to contribute two-fifths--instead of the current one-fourth--toward new bus purchases might stimulate reconsideration of the cost effectiveness of rehabilitating older buses. In certain instances, performance-oriented federal regulations would also permit state and local governments to implement more cost-effective programs than they now can.

For example, in the area of wastewater treatment, waivers of federal standards granted to certain specific projects could permit local authorities to save on wastewater treatment costs without compromising overall water quality.

Increasing the use of federal block grants for infrastructure would also give states and localities greater discretion to use available resources to meet their most pressing needs. Water resources investment priorities, for example, are shifting from large interstate developments to smaller intrastate projects. Replacing federal project-specific appropriations with block grants to states for any water development purpose might allow a closer match of authority and local priorities.

Rapid change in current arrangements, as with the other strategies, could impose transition costs for regions that have become heavily dependent on the current structure of federal aid. If the federal government reduced its matching share for new bus purchases from 75 percent to 60 percent, for example, localities would need to spend an estimated additional $100 million a year to replace buses at the current rate. (The rate of replacement might decline, however, with the diminution of the federal subsidy.) An inability to raise such funds quickly could result in reduced transit service, slowed bus sales, and dampened local economic activity. As before, this suggests that a gradual shift in federal investment practices might be the more appropriate course.

## CHAPTER II. HIGHWAYS

*From a federal perspective, the area of most pressing need is the heavily traveled Interstate System, which, though not yet complete, suffers from accelerating deterioration. Though lesser roads also show signs of neglect, the Interstate System confers the clearest economic benefit to the nation as a whole. The federal cost of meeting major highway needs (including bridge work) is roughly $13.1 billion a year through 1990, of which the Interstate share would be some $7.5 billion. In size, the current federal commitment of $12.7 billion a year to highways seems reasonably matched to needs, and collections from user charges, substantially increased by 1982 legislation, cover federal costs adequately. But the structure of current policies does not always foster effective investment. Favoring new construction, current policies do not do enough to meet mounting needs for repair, resurfacing, and rehabilitation; by offering high federal matches to states and localities for construction investment, current policies promote states and localities to neglect repair. A redirection of policies to increase federal funding for nonconstruction purposes and/or to limit the federal role to those areas of clearest national importance would permit a reduction in federal highway taxes.*

### THE PROBLEMS IN HIGHWAYS

Of the nation's 3.9 million miles of roads, the most important are the 20 percent that make up the 820,000 mile Federal-Aid System. 1/ Besides its 260,000 bridges, the system has four major parts: more than 40,000 miles of Interstate routes, 260,000 miles of major Primary System arterials, nearly 400,000 miles of rural collector routes in the Secondary System, and another 125,000 miles in the Urban System (see Table II-1). Altogether, the Federal-Aid System carries four-fifths of the nation's highway traffic, but on only about one-fifth of the highways. The Interstate

1. Further analysis can be found in Congressional Budget Office, Financial Options for the Highway Trust Fund (December 1982).

TABLE II-1. MAJOR PARTS AND PHYSICAL STATUS OF THE NATION'S HIGHWAYS, BY FINANCING SOURCE

| Highways by Financing Category | Route Miles | Percent of Total Vehicle-Miles |
|---|---|---|
| Federal-Aid Highway System | | |
| Interstate | 41,216 | 19.0 |
| Primary [b] | 259,240 | 29.5 |
| Secondary | 398,108 | 8.7 |
| Urban | 124,115 | 21.9 |
| Bridges (number) | (259,950) | [c] |
| Total Federal-Aid [a] | 822,679 | 79.1 [b] |
| Non-Federal-Aid System | | |
| Roads | 3,034,179 | 20.9 |
| Bridges (number) | (313,700) | [c] |
| Total Roads | 3,856,858 | 100.0 |

(Continued)

SOURCE: Congressional Budget Office based on data in Federal Highway Administration Highway Statistics for 1980, and The Status of the Nation's Highways: Conditions and Performance (January 1981) and other data from the Federal Highway Administration.

System alone accounts for 1 percent of the nation's roads but carries about one-fifth of all traffic and nearly half of all travel by combination trucks (mostly 18-wheel tractor-trailer trucks).

## Physical Problems

The problems facing the Federal-Aid System over the next decade fall into the categories of repair and construction. Both the Interstate and other major road and bridge networks will need repairs, and construction of the

TABLE II-1. Continued

| Percent of Capital Spending Provided by Federal Government a/ | Percent in Poor Condition | Percent in Fair Condition |
|---|---|---|
| 91 | 8.2 | 34.1 |
| 70 | 8.9 | 51.5 |
| 25 | 13.9 | 62.4 |
| 20 | 10.7 | 59.8 |
| 70 | 10.5 | 15.5 d/ |
| 50 | 11.5 e/ | 57.2 e/ |
| f/ | f/ | f/ |
| f/ | 33.4 | 27.4 |
| f/ | f/ | f/ |

a. U. S. Department of Transportation, Final Report on the Federal Highway Cost Allocation Study (May 1982), p. iv-14. These estimates exclude maintenance.

b. Excludes Interstate mileage.

c. Not applicable because vehicle miles are the same as for roads.

d. These bridges do not have adequate capacity for existing traffic or do not meet current design standards despite adequately sound structure.

e. Excludes bridges.

f. Data not available.

Interstate system has yet to be completed. During the 1970s, highway construction costs rose even faster than inflation in general. At the same time, revenues from motor fuel taxes leveled off, as high energy costs slowed the growth in vehicular travel and encouraged the use of more fuel-efficient vehicles. 2/ The financial pressures resulting from these influences have forced many states to defer highway repairs. Even though almost half the states have raised their taxes on motor fuel in the past two years, income from such measures has not been enough to make up for purchasing power already lost to inflation.

Repair Needs of the Interstate System. The typical Interstate highway is designed to last for 20 years before it requires major rehabilitation. With construction on the Interstate system having begun in 1956, more than 41 percent of the system has already reached this milestone, and 75 percent of the system will have reached it by 1990. Data from the Department of Transportation's Federal Highway Administration (FHWA) show that 8 percent of Interstate mileage was in poor condition in 1981, unchanged from 1978 but up from 3 percent in 1975 (see Table II-2). 3/ In fact, pavement condition as a function of age shows a distinct pattern; the rate of deterioration tends to accelerate rapidly as roads enter the last quarter of their design lives (see Figure II-1). This means that, even as the Interstate system approaches completion, the rate of deterioration is rising.

Repair Needs of Other Federal-Aid Roads. The Primary, Secondary, and Urban systems of the Federal-Aid network also face problems of deferred repair. Though the fraction of these roads rated as being in poor condition remained relatively low in 1981, more than half of the Primary, Secondary, and Urban systems were in fair condition. Without more remedial work, an increase in roads rated poor is likely. The condition of roads not included in the Federal-Aid System is probably similar to or worse than the Secondary and Urban systems.

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2. Discussion of market swings toward fuel-efficient vehicles can be found in Congressional Budget Office, Fuel Economy Standards for New Passenger Cars After 1985 (December 1980).

3. Deteriorated roads are concentrated in a few states, with Michigan, Kansas, New Mexico, Wisconsin, and Missouri reported to have more than 50 percent of their Interstate roads in fair condition. Roads are rated by the FHWA on a scale of one to five based on a visual inspection of their condition. For example, a new road should receive a five and a good road four, while a road in fair condition rates a three. A poor road (two or worse for most roads and 2.5 or worse for Interstates) is one that cannot safely be used at its design speed.

TABLE II-2. RETROSPECTIVE OF PAVEMENT CONDITIONS ON THE FEDERAL-AID HIGHWAY SYSTEM FROM 1981

| System | Condition of Road (Percent in 1981) | | Change in Road Condition (Percentage Points) | | | |
|---|---|---|---|---|---|---|
| | | | From 1978 | | From 1975 | |
| | Poor | Fair [a] | Poor | Fair | Poor | Fair |
| Interstate | | | | | | |
| Rural | 8 | 34 | 0 | +2 | +5 | +4 |
| Urban | 9 | 35 | +1 | 0 | +3 | -1 |
| Primary [b] | | | | | | |
| Rural | 9 | 50 | +2 | -6 | 0 | -2 |
| Urban | 9 | 55 | +2 | -4 | +1 | -4 |
| Secondary [c] | 14 | 62 | -1 | -4 | 0 | -2 |
| Urban [d] | 11 | 60 | -1 | -5 | 0 | -5 |

SOURCE: Congressional Budget Office from data supplied by Federal Highway Administration.

a. The definition of a road in fair condition is not clear and other interpretations could result in inclusion of one-third or so fewer roads in this class.

b. Data for arterial roads.

c. Data for rural collector roads.

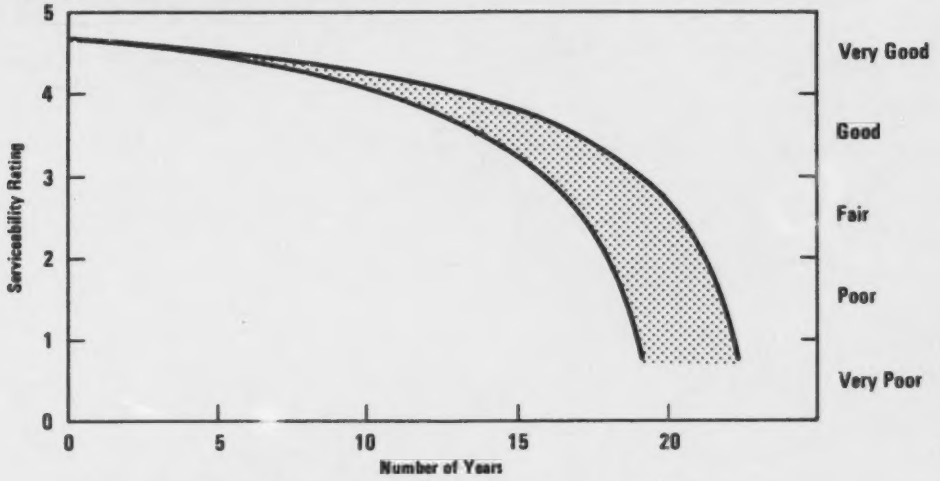
d. Data for urban collector roads.

The FHWA has identified 23 percent of the nation's 574,000 bridges as structurally deficient--roughly 10 percent of all bridges on the Federal-Aid System and one-third of other bridges. [4] Most of these deficient bridges

4. See Federal Highway Administration, Highway Bridge Replacement and Rehabilitation Program, Third Annual Report to the Congress (March 1982).

Figure II-1.

## Pavement Conditions as a Function of Age (for highways designed to last 20 years)




SOURCE: Congressional Budget Office from Federal Highway Administration data.

NOTE: Road serviceability measured on a scale of zero to five according to Federal Highway Administration ratings.

are still safe for light vehicles, but large trucks sometimes must be rerouted. Though only one-fifth of all structurally deficient bridges are on the Federal-Aid System, they tend to be the larger, more expensive ones.

Interstate Completion. As conceived, the Interstate System would have been completed in 1972, well before the first cycle of major repairs was to begin. That original goal has not been met. More than 96 percent of the system's planned 42,900 miles are now open to traffic, and the Congress has set a target date of 1990 for completion of the remaining 1,700 miles. The cost to complete this system--$36.3 billion--remains high, particularly because much of the mileage to be built is in urban areas, where construction is especially costly. 5/

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5. Urban roads tend to be more expensive because land costs are higher in cities and because space and time confinements make construction difficult.

Since the Interstate system was conceived, its definition has grown to include many roads that are of greater interest to states and localities than to the nation as a whole. Most of the roads yet to be built would serve commuter traffic. Only about half the remaining miles (and one-third the cost) can be considered primarily national routes needed for interstate travel. 6/

## Costs of Neglect

Keeping roads in good repair is critical because, as road conditions worsen, overall costs of using the roads increase substantially. Vehicle maintenance costs rise as roads become rougher, slower speeds lengthen travel times, travel distances grow as people reroute to avoid bad stretches, and accidents become more numerous. Though these costs cannot be calculated precisely, one recent study has found that operating costs on a road in poor condition may be 15 percent to 29 percent higher than the costs of using a road in good condition (see Table II-3). 7/ Although these are approximate estimates, poor roads clearly impose substantial costs on their users. In addition, road conditions deteriorate at increasing rates if needed repairs are not made. For example, about three-quarters of pavement deterioration occurs in the last two or three years of a road's design life. As a result, the long-run cost to the government can increase as repairs continue to be postponed.

Meeting the needs outlined above--repair of Interstate routes, repair of other Federal-Aid highways, and completion of the nationally important parts of the Interstate highway system--would require substantial funding. Altogether, the costs of attending to them would come to about $23.2 billion a year. As costs are now shared between the federal and state governments, the federal government would be responsible for $13.1 billion a year--a 50 percent increase over the federal spending in 1982 but only slightly more than the sums authorized for 1983-1986 under the Surface Transportation Assistance Act of 1982.

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6. See Congressional Budget Office, The Interstate Highway System: Issues and Options (June 1982).

7. See Federal Highway Administration, Office of Highway Planning, Vehicle Operating Costs, Fuel Consumption, and Pavement Type and Condition Factors, Final Report (June 1982), Appendix A.

TABLE II-3. INCREASES IN OPERATING COSTS AS A FUNCTION OF PAVEMENT CONDITION, BY VEHICLE TYPE (In percents)

| Pavement Condition | Small Auto | Two-Axle Truck | Five-Axle Truck |
|---|---|---|---|
| Very Good | 0.0 | 0.0 | 0.0 |
| Good | 2.0 | 1.1 | 2.5 |
| Fair | 11.0 | 6.1 | 10.9 |
| Poor | 29.0 | 15.3 | 26.6 |
| Very Poor | 38.0 | 22.2 | 39.8 |

SOURCE: Congressional Budget Office from data in Federal Highway Administration, Office of Highway Planning, Vehicle Operating Costs, Fuel Consumption, and Pavement Type and Condition Factors, Final Report (June 1982), Appendix A.

NOTE: Excludes labor costs. Includes fuel, oil, maintenance and repair, and depreciation. Cost changes assume 55 miles per hour and no grades.

## CURRENT POLICY IN HIGHWAYS

For 1983, about 85 percent ($10.7 billion) of the $12.7 billion available for federal highway spending (administered by the Department of Transportation) was allocated to programs for the Federal-Aid System. The remaining $2.0 billion serves a wide variety of purposes, from regional development to safety-related grants. In recent years, the total funding for these miscellaneous programs has declined.

## Evaluation of the Federal Role

Since the modern highway program began in 1916, federal highway spending has passed through several cycles. 8/ The underlying rationale for federal involvement in highways rests on the need for a coordinated national road network to facilitate the nation's commerce. Though some parts of this network could be self-supporting as toll roads, the network as a whole requires government support. Over time, the federal program expanded with the addition of new programs, and the mileage included in the Federal-Aid System grew from 169,000 miles and 5 percent of the nation's roads in 1923 to 820,000 miles and more than 20 percent of the route-miles at present.

In 1956, the Congress created the Highway Trust Fund to provide a stable way to finance construction of the Interstate Highway System. Federal user fees were increased, with the most important tax--that on motor fuel--going from 1.5 cents per gallon in 1956 to 3 cents in 1957 and 4 cents in 1959. In contrast to the rest of the highway network, in which states have broad latitude concerning which routes to include, the federal government specifies which routes are eligible to be part of the Interstate highway program, and it provides the funds to build those routes on highly attractive terms.

## Origins of the Matching System and the Status Quo

In 1956, in recognition of their importance for national growth, the Interstate routes became eligible for 90 percent federal financing, rather than the 50 percent federal support that the other Federal-Aid roads received. In 1974, the federal share for non-Interstate projects was increased from 50 percent to 70 percent, and four years later, to 75 percent for most programs. Nevertheless, because state and local governments have spent more than they have had to just to match federal dollars, the federal share of overall highway spending has been substantially less, averaging about 30 percent for the last 25 years. 9/ State governments now supply about half the spending, with cities, counties, and other local governments providing the remaining 20 percent.

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8. For more details, see Congressional Budget Office, Highway Assistance Programs: A Historical Perspective (February 1978).

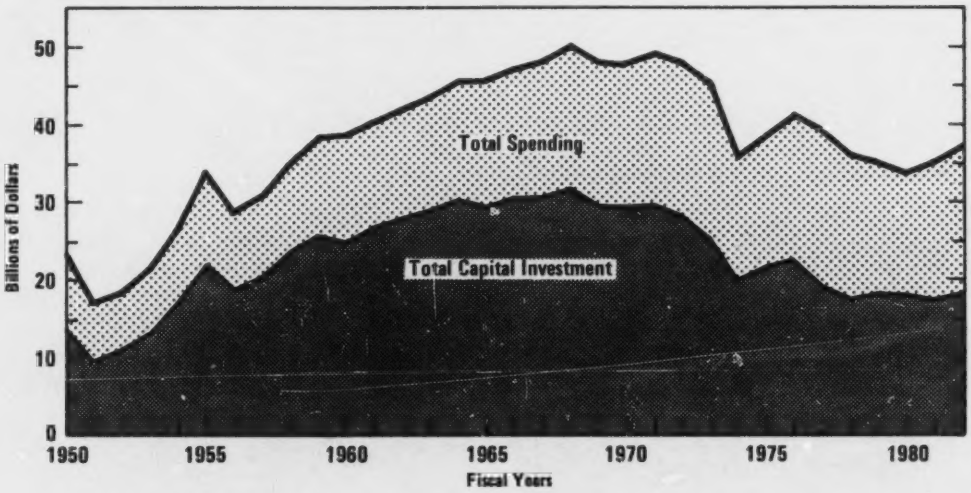
9. Unless states increase their spending as well, the major jump in federal spending called for by the Surface Transportation Assistance Act of 1982 may cause the first major shift since the late 1950s.

Today, federal funds are concentrated on specific roads and activities, and they account for about half of the spending for construction and major repair of the Federal-Aid highway system. Most state and local spending goes for roads that are not included in any of the various federal systems sketched above; much goes toward more locally oriented federal roads (mainly the Secondary and Urban systems) and for routine maintenance--pothole filling and grass mowing, for example--on all road systems.

In 1982, all three levels of government together spent about $37 billion on highways, of which about half represents capital spending for new construction and major repair work (see Figure II-2). In terms of purchasing power, this level of spending is equivalent to that of the late 1950s, shortly after the start of the federal Highway Trust Fund. Public spending on highways peaked in 1969 at close to $50 billion (expressed in 1982 dollars).

Figure II-2.

## Capital Investment as a Proportion of Total Public Highway Spending, 1950-1982




SOURCE: Congressional Budget Office from Federal Highway Administration data.

The bulk of government spending on highways is financed by different taxes on highway users. The most important of these are the taxes on motor fuel--now 9 cents a gallon at the federal level under the 1982 legislation and an average of about 10 cents a gallon at the state level. More than

95 percent of federal highway spending is financed by users, and about 60 percent of state and local spending also comes directly from users.

## Estimated Needs Under Current Policy

According to FHWA estimates, eliminating all sections of poor road from the Interstate highways and keeping the system in repair would cost around $2.8 billion a year through the rest of the 1980s. The federal share, matching 90 percent of these costs, would average $2.5 billion (see Table II-4).

Over the rest of this decade, the total costs to all levels of government of preventing further deterioration in the Primary, Secondary, and Urban systems are estimated at $27, $22, and $18 billion, respectively. 10/ These sums include the cost of adding road capacity to accommodate expected growth in traffic; overall, roughly one-third represents new construction. If federal support for these programs continues in the same proportion to total spending as in the past, then the annual federal share of spending for these roads over the next four years would average $?.7 billion, $0.6 billion, and $0.5 billion for the Primary, Secondary, and Urban systems, respectively. 11/

Replacing or rehabilitating all the nation's deficient bridges over an unspecified period would cost about $40.5 billion. 12/ About half of this sum ($20.1 billion) would go for bridges on the Federal-Aid System, including $8.7 billion for bridges on the Primary and Interstate systems. The costs to replace or rehabilitate these bridges by 1990 would total about $2.5 billion a year. At present, the federal government pays for about 70 percent of the costs of bridge repair and replacement on the Federal-Aid System, so $1.8 billion would be required as the federal share. 13/

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10. Unpublished estimates from Federal Highway Administration.

11. For the Secondary and Urban roads, this assumes that the federal government would pay about 20 percent of total capital spending, and that it would pay about 70 percent of the total for the Primary system.

12. See Federal Highway Administration, Highway Bridge Replacement and Rehabilitation Program, Third Annual Report to the Congress (March 1982).

13. See General Accounting Office, Better Targeting of Federal Funds Needed to Eliminate Unsafe Bridges (August 1981).



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TABLE II-4. CUMULATIVE COSTS ASSOCIATED WITH MAJOR NATIONAL HIGHWAY NEEDS OF THE FEDERAL-AID SYSTEM (1983-1990)

| Area of Need | Effective Federal Share of Spending (In percent) a/ | Average Annual Authorizations (In billions of dollars) | | |
|---|---|---|---|---|
| | | Total Estimated Needs | Federal Share of Estimated Needs | State and Local Share of Estimated Needs |
| Complete Interstate System by 1990 | 90 | 4.5 | 4.1 | 0.4 |
| Interstate Repair | 90 | 2.8 | 2.5 | 0.3 |
| Interstate Reconstruction | 25 b/ | 3.6 | 0.9 | 2.7 |
| Primary | 70 | 3.9 | 2.7 | 1.2 |
| Secondary | 20 | 3.2 | 0.6 | 2.6 |
| Urban | 20 | 2.7 | 0.5 | 2.2 |
| Bridge Repair | 70 | 2.5 | 1.8 c/ | 0.7 |
| Total d/ | 56 | 23.2 | 13.1 | 10.1 |

SOURCE: Congressional Budget Office from unpublished data provided by the Federal Highway Administration, except as noted below.

a. Department of Transportation, Final Report on the Federal Highway Cost Allocation Study (May 1982), p. iv-14. These represent federal share of highway spending after accounting for state-only projects.

b. Congressional Budget Office assumption.

c. Federal Highway Administration, Highway Bridge Replacement and Rehabilitation Program, Third Annual Report to the Congress (March 1982). Assumes an eight-year program and is restricted to the Federal-Aid System.

d. Excludes Interstate transfer grants for highways, safety, recreational roads, and roads off the Federal-Aid System. Needs for roads and bridges off the Federal-Aid System are difficult to estimate but could reach $4 billion to $5 billion a year.

## EFFICIENCY OF CURRENT HIGHWAY SPENDING

In size, the current federal commitment is roughly in line with the needs for highway infrastructure. Federal money could be better targeted to the areas of greatest need, however. For example, the most significant national highway problem appears to be the deteriorating condition of the Interstate System and certain other important parts of the Federal-Aid network. Yet large sums continue to be devoted to construction of Interstate highways, even though less than half of the remaining cost is related to completing an interconnected system of intercity roads. Similarly, a large portion of the $2.3 billion in federal funds for the Interstate "4R program" (repair, resurfacing, restoration, or reconstruction) will be used for reconstruction work only. 14/ This is an area of considerably lower federal priority than repairing the completed system.

## FEDERAL STRATEGIES TO IMPROVE HIGHWAY INVESTMENT

Of the three general strategies outlined in Chapter I--greater use of federal user fees, better targeting of federal dollars, and limiting federal funding to areas of clear national need--the latter two are most applicable. By and large, current federal outlays are already recovered from users, and charging highway users for their congestion and environmental costs presents technical and political problems. This does not mean that the current federal highway taxes could not be made more equitable--taxes on heavy trucks in particular are too low by about one-third. But any shift in truck taxes would be unlikely to change the overall level of demand for highways; further, since taxes are such a small part of truck operators' costs, higher taxes might not cause much change in the way highways are used. 15/

Instead of continuing current spending patterns, two broad options illustrate possible ways to improve the alignment of federal funds and highway needs: a retargeting option that would adjust federal authorization

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14. The term reconstruction is a misnomer, since none of the projects involves the repair of existing highways. Rather, reconstruction refers to special types of new construction--added lanes and interchanges, for example.

15. Highway user taxes account for less than 2 percent of total trucking costs, which include the costs of the driver and distribution costs. Even full recovery of the costs that heavy trucks impose on federal highways would increase total costs by less than 1 percent.

levels to match needs more closely; and a restricted federal role in which support would be concentrated exclusively on the Interstate and Primary systems.

## A Retargeted Program

A retargeted program's greatest effect would be to shift more funds to repair of the Interstate System (see Table II-5). Such action could yield a marked improvement in road conditions. This could be achieved by lowering the 90 percent federal match for so-called reconstruction projects--mostly locally oriented additions to Interstate roads that do not involve repair work. The current repair program authorization of $2.3 billion a year appears inadequate, in large part because repair funds can also go toward other uses. But funds for completion of the Interstate System could be decreased from $3.6 billion to $1.7 billion by completing only those roads of clearly national significance.

A total of $2.8 billion a year is needed for Interstate repair and resurfacing alone, with an additional $3.6 billion in demand for reconstruction. Other major changes could change authorization levels to meet the estimated level of needs shown in Table II-4. These could include increasing average annual authorizations for the Primary system from $1.9 billion a year to $2.7 billion, and for bridges from $1.6 billion to $1.8 billion.

Implications for the Federal Budget. This option would require slightly less in funding than the current level of spending, resulting in a saving of about $1.3 billion a year. But if no change were made in the extent of the Interstate System, a total of $4.1 billion a year would be required--$2.4 billion more than CBO has assumed for this option. This would require a further tax increase of about 1 cent per gallon.

Implications for State and Local Governments. This revised program, because it would involve the largest commitment of funds to highway repair and construction, would not shift major cost burdens to state and local governments. Indeed, it would provide considerable aid for state highway departments, because it would continue federal funding for Secondary and Urban roads at a high level. Because state and local governments already build projects on these systems using 100 percent state funds, most states would be readily able to furnish adequate funds to match federal spending. Without substantial increases in their highway taxes, however, the states would be unable to increase their highway spending generally in parallel with the recent federal increase.

TABLE II-5. FEDERAL HIGHWAY PROGRAM UNDER THREE OPTIONS--AVERAGE ANNUAL AUTHORIZATION, 1983-1986 (In billions of dollars)

| Program | Current Program | Better Targeted Program | Restricted Federal Role |
|---|---|---|---|
| Interstate Completion | 3.6 | [illegible] | 1.7 a/ |
| Interstate Repair | 2.3 | 2.5 | 2.5 |
| Interstate Reconstruction | | 1.6 | 1.6 a/ |
| Primary | 1.9 | 2.7 | 2.7 |
| Secondary | 0.6 | 0.6 | 0.0 |
| Urban | 0.7 | 0.5 | 0.0 |
| Bridges | 1.6 | 1.8 | 0.8 b/ |
| Other c/ | 2.0 | 0.0 | 0.0 |
| Total | 12.7 | 11.4 | 9.3 |

SOURCE: Congressional Budget Office from unpublished data from Federal Highway Administration, except as noted below.

a. Assumes intermediate Interstate construction option from Congressional Budget Office, The Interstate Highway System: Issues and Options (June 1982).

b. Includes only Interstate and Primary systems' share of bridge program.

c. Includes Interstate transfer grants, safety programs, and development highways.

## Restricted Federal Role

Though federal, state, and local highway interests often overlap, the extent of national interest varies considerably among the various highway programs. The Congress might therefore wish to consider a shift in federal and state and local government highway roles. If existing federal highway resources were concentrated exclusively on roads of greatest national importance, aid for all but the Interstate and Primary systems, along with their related bridge projects, could be dropped (see Table II-5). Even with somewhat reduced total federal expenditures, this option could permit completion of the nationally important portions of the Interstate System by 1990 and would still provide adequate funds for repair of the Interstate and Primary systems.

The predominant federal interest in the nation's highway system is reflected in those roads that link activities--and hence commerce--in different states; overall, these roads account for about 68 percent of the federal programs. The unique scope of the Interstate System gives rise to an exceptional federal interest in this program compared with other highway activities. Similarly, Primary routes are also a major federal concern: in rural areas, these routes carry twice as much interstate traffic as does the Interstate System. A second group of programs--the rest of the Federal-Aid System--can be considered a form of intergovernmental reimbursement. Federal spending accounts for only about 20 percent of total government capital spending on the Secondary and Urban systems. States carry the bulk of the burden for these systems, and federal aid has relatively little influence on the total amounts spent. These programs account for another 16 percent of federal highway spending. The final group of programs represent a mix of safety, economic development, and special regional concerns of particular interest to state and local governments, which are in the best position to make effective project choices. Total costs for these federal programs come to 16 percent of spending.

Implications for the Federal Budget. This option would require $3.4 billion a year less than would current policies. If highway taxes were not changed, the federal deficit could be narrowed by about $3.4 billion a year. Alternatively, federal highway tax revenues could be reduced by $3.4 billion (with fuel taxes cut by 3 cents a gallon), leaving the states the opportunity to raise their taxes to compensate for lost federal dollars.

Implications for State and Local Governments. Such a shift would place the full burden of financing Secondary and Urban roads on state and local governments. To accommodate the shift, they would be forced to increase taxes or spend less per mile of road in their care. This burden could be eased by reducing the federal tax on motor fuel by 3 cents per

gallon, permitting the states to raise their tax revenues by $3.4 billion a year--enough to replace fully the reduced federal aid. As the federal tax was phased out, state and local governments could increase their own highway taxes to finance, on a permanent basis, the programs dropped by the federal government. The federal government would continue to finance Interstate and Primary roads, and at a higher level than they now do. A potential problem is that, as the states increased their own user fees, there is no assurance that the resulting distribution of cost recovery would either be uniform among the states or applied in the most economic manner.

## CHAPTER III. PUBLIC TRANSIT

*While local fiscal constraints have forced many transit authorities to neglect the worsening physical conditions of older-generation rail systems, high federal capital grants (80 percent of investment costs through 1982, now 75 percent) have induced some cities to start new capital-intensive systems, particularly rail. (By and large, the transit bus fleets are in adequate condition.) The allocation of federal grants appears to favor urban areas with less pressing needs rather than the most transit-dependent cities. Not enough of the $3.7 billion available for distribution as federal capital grants goes toward mounting repair and rehabilitation needs, although the overall sum appears ample to meet transit needs as estimated by CBO at $3.6 billion a year through 1990. Adjustment in federal policies to improve the cost effectiveness and targeting of spending could permit transit needs to be met within current federal spending, and might even allow a reduction in the penny of the new tax on motor fuel that goes to transit. Such changes could include lowering the federal matching ratio, revising the distribution formula to favor cities that rely most heavily on transit, disbursing federal monies in transit block grants with few federal stipulations as to their use, and permitting experimentation with nontraditional modes.*

### THE PROBLEMS IN MASS TRANSIT

From a national perspective, public transit has accounted for only a small share of all work-related travel, declining from 9 percent in 1970 to 6 percent in 1980. Cars carrying only a driver accounted for 64 percent of all work trips in 1980, while carpools and van pools together made up 20 percent. The remaining 10 percent represent people who walk, ride bikes, or work at home. 1/ But the older, more densely populated cities,

1. See Philip N. Fulton, "Public Transportation: Solving the Commuting Problem?" U.S. Bureau of the Census, presented at Transportation Research Board Annual Meeting (January 1983).

such as New York City, Chicago, Philadelphia, and Boston, depend heavily on their public transit systems to handle daily commuter traffic and downtown circulation. In New York City, the most transit-dependent of all U.S. cities, public transportation handles more than half of all work trips and three-fifths of all trips made within the city on a typical day. 2/ Of the roughly 8 million mass transit trips made in the United States in 1981, 70 percent were by bus and the rest on rail systems, which include "heavy rail" (subways), "light rail" (trolley), and commuter railroads. Fully one-third of these trips were concentrated in the New York metropolitan area.

Two factors shape the need for future investment in mass transit: deterioration of existing facilities, and demand for new capacity. Over the last decade, rapidly growing operating deficits have forced many cities to defer normal maintenance.

## Deterioration of Existing Facilities

The condition of the nation's public transit systems varies widely depending on age, patterns and intensity of use, levels of maintenance, and external factors such as climate. Various aging transit system components--including rail track, buses and rail cars, and bus and rail car garages--will probably require rehabilitation or replacement in the coming decade. Physical deterioration is especially severe on the older rail transit systems of New York, Chicago, Philadelphia, and Boston. Except for vehicle replacement, most of these problems represent a backlog of postponed needs rather than a recurring or new problem.

Though the nation's bus fleets are in substantially better condition than they were a decade ago, the relatively short effective life of a transit bus (12 to 15 years) means that the need for steady funding of buses will continue. Aging bus fleets are not a serious financial or physical problem, however; the Department of Transportation's Urban Mass Transportation Administration (UMTA) recently estimated that more than 95 percent of the nation's total bus fleet is less than 20 years old. 3/ But some bus facilities, such as garages, are old, and these may need to be modernized or replaced sometime in the near future.

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2. See New York City Planning Commission, Capital Needs and Priorities for the City of New York (1982), p. 202.

3. See Urban Mass Transportation Administration, National Urban Mass Transportation Statistics, Second Annual Report, Section 15 Reporting System (November 1982).

Age alone does not determine the need for bus or subway car replacement; patterns of use are as important a factor. Some New York City buses, for example, show severe wear after just nine years of service, partly because of overloading and use on highly congested, pothole-ridden streets. 4/ Inadequate maintenance may also outweigh age as a cause of transit inefficiency. In 1971, the New York City Transit Authority's older subway cars had a breakdown rate of once per 24,000 miles of operation. Today, the failure rate has increased dramatically to once every 6,500 miles, and old and new cars break down with virtually the same frequency. 5/

High failure rates can have important implications for transit authority finances, because ridership--hence fare revenues--is considerably more sensitive to passengers' comfort and convenience than it is to fare levels. 6/ Thus, continuing to neglect repair and maintenance needs could result in increased road traffic congestion and wasted fuel, and in greater expenses for businesses and private individuals alike. Over the long term, an area's economic development can suffer. 7/ These costs are likely to be concentrated in the older, densely populated cities that depend most on mass transit.

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4. See City of New York, Office of the Comptroller, Rebuilding During the 1980s (May 7, 1979), pp. 187-189, cited in Nancy Humphrey, "Assessing Infrastructure Needs," the Urban Institute (December 1980), pp. 6-7.

5. See George Haikalis in Committee for Better Transit, Inc., Notes from Underground, Volume 13, Numbers 3 & 4 (June-July 1982), p. 2.

6. See, for example, Ecosometrics, Incorporated, Patronage Impacts of Changes in Transit Fares and Services, prepared for Urban Mass Transportation Administration (September 1980), and David Lewis, "Estimating the Influence of Public Policy on Road Traffic Levels in Greater London," in Journal of Transport Economics and Policy, volume XI, No. 2 (May 1977).

7. See the discussion in John R. Meyer and Jose A. Gomez-Ibanez, Autos, Transit, and Cities, 1981, Chapter II ("Traffic Congestion"). The authors conclude that traffic congestion "is not a problem that can or should be totally eliminated," however; "the proper policy goal is attenuation" (p. 229). And in The Urban Transportation System: Politics and Policy Innovation (1979), Alan Altshuler notes that no "discernible progress has been made in specifying the relationship between congestion and aggregate economic activity--within any metropolitan area, let alone the nation as a whole" (p. 323).

## Demand for Increased Transit Capacity

The second major demand for transit funds is likely to come from the newer, rapidly growing cities that now have no rail transit systems. During the 1970s, the rapid growth in federal funding for transit made possible significant additions to rail transit capacity, and a generous federal match for local investment induced some cities to choose rail over other, less costly transit alternatives. 8/ With the addition last year of more funds for transit, many cities (Houston and Los Angeles, for example) have indicated a wish to build new subways.

## CURRENT POLICY IN PUBLIC TRANSIT

The federal government's involvement in funding mass transit has been motivated by the perception that, without help, localities cannot afford all the capital investment necessary to build and maintain public transportation systems. In addition, federal involvement has been justified on grounds that transit can help attain several important social and economic objectives. These include easing urban road traffic congestion, saving energy, curbing pollution, and providing a way for people without cars to get to work.

## Development of Federal Role

Early in this century, mass transit was dominated by private firms that operated as profitable businesses, including many subsidiaries of firms in related businesses, such as land developers and electric power companies. With the proliferation of private cars after World War II, urban populations and employment, once concentrated in city centers, became more dispersed. As a result, transit ridership declined by about 65 percent between 1945 and 1965, and many privately owned transit companies failed. By the early 1960s, the physical decrepitude resulting from deferred maintenance had reached crisis proportions in most of the remaining private systems. 9/ As private investment in transit declined, federal funding began, though on a small scale, in 1963. The main purpose was to allow localities to purchase

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8. See Consad Research Corporation, A Study of Public Works Investment in the United States, for U.S. Department of Commerce, volume III, pp. 69-70 (April 1980).

9. George W. Hilton, Federal Transit Subsidies, American Enterprise Institute (1974).

failing private bus lines and upgrade equipment. During the early 1970s, the capital program expanded dramatically, permitting greater use of funds for both existing and new rail systems. The federal government's transit program is now run by the Urban Mass Transportation Administration (UMTA).

During the 1970s, federal transit aid grew at a 40 percent annual rate--faster than any other transportation program. Federal funding for capital grants climbed from $174 million in 1965 to $2.9 billion in 1981 (see Figure III-1) and totalled $2.6 billion in 1982 (see Table III-1). At least $0.6 billion more was provided by state and local governments to meet the 20 percent local matching requirements. In addition, some large cities (notably New York) financed major investments with their own monies. Current federal authorizations total $3.7 billion a year.

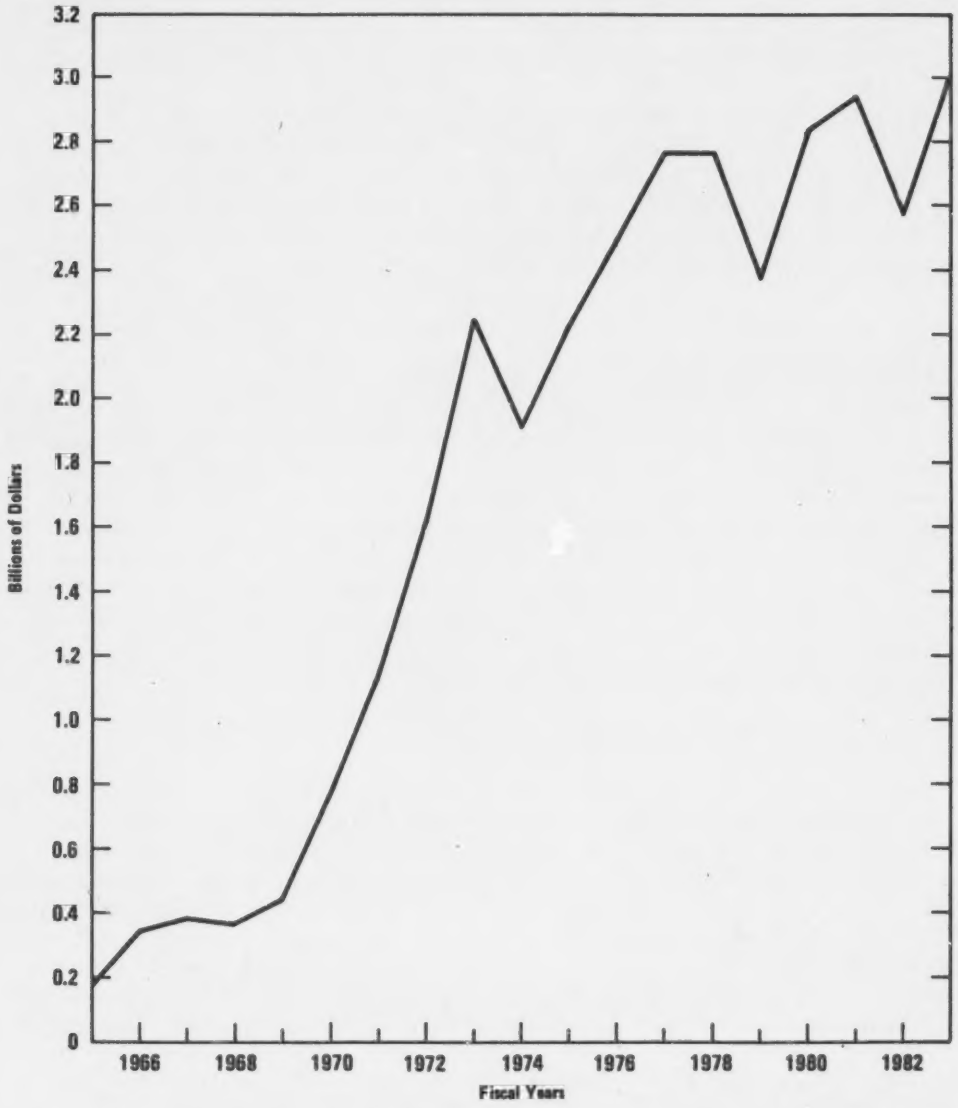
In many cities, fares were held down to encourage ridership. But as systems expanded, transit labor and other costs rose dramatically. As a result, operating deficits grew so large that most systems came to rely on the fare box for less than half their operating costs. In 1975, as cost burdens increased, operating subsidies were added to the federal aid program, peaking in 1981 at $1.1 billion. More recently, the Surface Transportation Assistance Act of 1982 limited federal operating assistance to $0.9 billion a year through 1986. This act dedicated to transit capital grants the revenues from a penny of the tax on motor fuel--permitting an increase in authorizations of $1.1 billion a year. In addition, the basic federal match for capital grants was reduced from the previous 80 percent to 75 percent.

## Federal Aid to Mass Transit Under Current Policy

Unlike most other federal programs for infrastructure services, virtually all transit grants go to local rather than state governments, and transit operators are largely responsible for the selection and management of projects. The federal government provides 75 percent or more of each project's cost, with the balance shared by state and local governments. After receiving federal and state contributions, a typical city may pay less than 10 percent of the costs of a project. For 1982, almost two-thirds of all federal capital grants were made at the discretion of the UMTA administrator. As a rule, most bus-related projects are approved, while proposals for new rail systems receive closer scrutiny and may be delayed or even rejected. There is also a "formula grant" program for routine bus investments, which include replacements. These funds are allocated to urban areas according to a formula based on vehicle miles of operation and population size and density. In addition, capital funds are also provided by

Figure III-1.

## Total Federal Funding for Public Transit Capital Grants, 1965-1983




SOURCE: Congressional Budget Office from Urban Mass Transportation Administration data and Federal Highway Administration.

TABLE III-1. FEDERAL CAPITAL GRANTS FOR PUBLIC TRANSIT, 1982

| Program | Estimated Grant Funding (In millions of dollars) | Typical Projects Funded |
|---|---|---|
| Discretionary Grants | 502.3 | Bus fleet and service expansion |
| | 704.0 | Rail system modernization |
| | 144.9 | Rail system extension |
| | 225.4 | New rail systems |
| | 57.9 | Others a/ |
| Subtotal | (1,634.5) | |
| Capital Formula Grants | 297.7 | Bus replacement |
| Interstate Substitutions b/ | 567.9 | Rail system extensions, new rail system construction, bus purchases |
| Small Urban and Rural Capital | 18.2 | Capital aid for transit in small urban c/ and rural areas |
| Federal Aid to Urban Systems d/ | 52.6 | Rail modernization and bus replacement |
| Grand Total | 2,570.9 | |

SOURCE: Congressional Budget Office from Urban Mass Transportation Administration data.

NOTE: Details may not add to total because of rounding.

a. Includes funding for privately provided public transit service for the elderly and handicapped, and the Urban Initiatives program supporting intermodal transfer and joint development projects. Urban Initiatives were discontinued in 1982.

b. Various capital mass transit projects substituted for withdrawn segments of the Interstate Highway System, but subject to appropriations and financed out of the general fund rather than the Highway Trust Fund.

c. Urban populations below 50,000.

d. Transit capital projects financed by Highway Trust Fund.

"interstate substitution grants" for cities that have decided not to build particular segments of the Interstate Highway System. 10/

## Trends in Federal Program Emphasis

Throughout its history, the federal program of transit capital assistance has focused on big cities. From 1965 to 1976, six large cities received two-thirds of federal capital funding commitments, and ten urban areas together accounted for four-fifths. 11/ Even so, the very largest cities have not received funds in proportion to their shares of the nation's transit riders (see Table III-2). This reflects an apparent desire to encourage transit growth elsewhere in the country and a belief that the largest cities may be more willing and able to finance transit on their own. As federal funding increased in the 1970s, commitments were made to construct new rail systems in Atlanta, Baltimore, Buffalo, Miami, and Washington, D. C.

In recent years, growing recognition of the need to rehabilitate existing rail transit facilities has combined with increasing reluctance to commit federal funds to build costly new fixed rail transit systems. 12/ In 1978, the Surface Transportation Act specifically required that a minimum of $350 million be spent each year to modernize existing systems. In 1982, the Administration proposed ending all federal aid for construction of new rail systems and extensions of existing rail systems (excluding projects already approved) and targeting federal capital assistance exclusively to-

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10. If the Federal Highway Administration agrees that a particular route is not "of national significance" (see Chapter II), the city has the option of using these funds, subject to appropriations, either for transit or for other highway projects. In contrast to the rest of the transit program, the federal government has relatively little influence over where or how these grants are used. Interstate transfer grants are available on an 85 percent federal match.

11. See Consad Research Corporation, A Study of Public Works Investment in the United States (April 1980), prepared for U. S. Department of Commerce, Volume III, pp. 52-53. In order of decreasing size of commitments, recipients include the Tri-State area constituting New York City and environs, Boston, Chicago, Atlanta, San Francisco-Oakland, Washington, D. C., Philadelphia, Baltimore, Seattle, and Pittsburgh.

12. For further analysis, see Congressional Budget Office, Urban Mass Transportation: Options for Federal Assistance (February 1977).

TABLE III-2. DISTRIBUTION OF TRANSIT USE AND FEDERAL AID BY CITY AND POPULATION (Shares of total in percents)

| Urban Area | Nationwide Mass Transit Work Trips a/ | Federal Capital Grants, 1964-1980 b/ | Federal Operating Aid, 1964-1980 b/ |
|---|---|---|---|
| New York | 28 | 20 | 22 |
| Los Angeles | 4 | 2 | 9 |
| Chicago | 9 | 8 | 8 |
| Philadelphia | 5 | 6 | 5 |
| Subtotal | (46) | (36) | (44) |
| Other over 750,000 | 29 | 53 | 34 |
| 200,000-750,000 | 20 | 8 | 15 |
| 50,000-200,000 | 5 | 3 | 7 |
| Total | 100 | 100 | 100 |

SOURCES: See notes below.

a. Congressional Budget Office, from Bureau of the Census, 1980 Census, Journey-to-Work Trips in Standard Metropolitan Statistical Areas (forthcoming).

b. Congressional Budget Office.

ward improvement and modernization of existing facilities, including bus and rail rolling stock replacement. 13/

13. This policy appears to have been changed as a result of the extra $1.1 billion a year in transit funds provided under the Surface Transportation Assistance Act of 1982 as part of the 5-cent-per-gallon increase in the motor fuel tax.



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## Estimates of Transit Investment Needs Under Current Policy

Over the next decade, UMTA estimates the nation's public transit systems would require an annual investment of about $3.3 billion to repair, modernize, or replace existing facilities (see Table III-3). 14/ The American Public Transit Association (APTA), an organization of local transit system operators, estimates the potential need for new and expanded rail transit systems at $2.2 billion a year. 15/ Combined, these estimates total $5.5 billion a year--60 percent for repairing, modernizing, and replacing existing facilities, and 40 percent for expanding rail transit capacity.

Repair, Modernization, and Replacement. Of the $3.3 billion total annual investment, two-thirds would be needed to restore existing rail rolling stock, track, and maintenance facilities to good condition. This estimated need is geographically concentrated, with two cities--New York and Chicago--accounting for more than half the costs. A significant portion of this estimate represents a backlog of unmet past needs, since much normal maintenance has recently been deferred because of the fiscal straits of city governments. Rail rolling stock modernization requirements of $500 million a year are based on an UMTA survey that asked transit authorities to estimate their current needs, an approach that can at times lead to overestimates.

According to UMTA, a further $1.1 billion per year would be needed for bus systems. Of this sum, bus repair and replacement account for just over half--$610 million a year. About three-quarters of this $610 million would be spent in 17 percent of the nation's urban areas, since buses are concentrated in these areas and since buses in larger cities have a shorter life expectancy. The ten largest cities account for at least half of these needs. In addition, UMTA estimates $500 million a year would be needed to replace

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14. Urban Mass Transportation Administration, "10-Year Federal/State/Local Transit Investment Requirements," estimates prepared as part of the Department of Transportation's study of gasoline tax proposal that culminated in the Surface Transportation Assistance Act of 1982.

15. American Public Transit Association, "Rail Capital Needs, February 1982 Update," and Testimony before the House Committee on Public Works and Transportation, Subcommittee on Surface Transportation (February 24, 1982). Needs assessments have at times led to overstated estimates in other areas of transportation such as local Interstate highways. In part, this may result from the lack of objective standards for assessing potential investments.

TABLE III-3. ANNUAL PUBLIC TRANSIT REPAIR, MODERNIZATION, REPLACEMENT, AND ADDITIONAL CAPACITY NEEDS UNDER CURRENT POLICY, 1983-1990
(In millions of dollars)

| Category and Program | Annual Needs | | | |
|---|---|---|---|---|
| | High Estimate | | Low Estimate | |
| | Total | Federal Share at 75 Percent | Total d/ | Federal Share at 75 Percent |
| **REPAIR, MODERNIZATION, AND REPLACEMENT** | | | | |
| Bus Rehabilitation and Replacement | 610 a/ | 458 | 610 | 458 |
| Bus Maintenance Facilities Modernization | 500 a/ | 375 | 340 | 255 |
| Rail Rolling Stock Replacement and Modernization | 500 a/ | 375 | 250 | 188 |
| Track and Signal Improvements | 1,200 a/ | 900 | 1,200 | 900 |
| Rail Maintenance Facilities Modernization | 500 a/ | 375 | 500 | 375 |
| Subtotal b/ | (3,310) | (2,483) | (2,900) | (2,175) |
| **ADDITIONAL CAPACITY** | | | | |
| Rail System Extensions | 1,191 c/ | 893 | 500 | 375 |
| New Rail Systems | 1,012 c/ | 759 | 200 | 150 |
| Subtotal b/ | (2,203) | (1,652) | (700) | (525) |
| Total Needs | 5,513 | 4,135 | 3,600 | 2,700 |

SOURCES: See notes below.

a. Congressional Budget Office from Urban Mass Transportation Administration, 10-Year Federal/State/Local Transit Investment Requirements, 1982.

b. Details may not add to totals because of rounding.

c. Congressional Budget Office from American Public Transit Association, Rail Capital Needs, February 1982 Update.

d. Congressional Budget Office modification of high estimates.

bus garages, but this estimate may be high. APTA has estimated the requirement at $340 million a year--only two-thirds of UMTA's figure. 16/

Additional Rail Capacity. Additions to existing rail systems, costing some $1.2 billion a year, would link suburbs of Boston, Pittsburgh, Philadelphia, and other cities with their downtown areas. According to APTA estimates, the construction of new subway systems in Los Angeles, Houston, Honolulu, San Jose, San Diego, and elsewhere would require an additional $1 billion a year between 1983 and 1990. (The costs of rail systems now well under way, such as those in Washington, D. C. and Baltimore, are included in one of these two groups.)

## EFFICIENCY OF CURRENT PROGRAMS

The 75 percent federal match, usually augmented by state money, gives local authorities an incentive to buy new equipment rather than invest in continued maintenance and repair of existing equipment. For example, UMTA guidelines automatically allow replacement of buses 12 or more years old. If all costs are considered, however, rehabilitating the older buses and keeping them in service longer may actually be more cost effective.

The formula guiding bus replacement grants may also tend to favor certain areas in less need than others. Distribution based in part on population size and density, and not solely on measures of bus age or use, means that some cities with fleets in relatively good condition may receive too much assistance, while other areas with more serious need to upgrade their bus fleets may receive too little.

Estimates of the cost effectiveness of expanded transit capacity often derive from presuppositions rather than numerical analysis. For example, a major benefit commonly attributed to new rail lines is reduced road congestion. But recent studies indicate that, although new rail systems do attract bus and carpool passengers, they do not significantly reduce the number of automobiles on the roads. 17/ Another important assumption underlying the justification for new rail systems is their energy-saving potential. In this area, evidence suggests that new subway systems probably

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16. See American Public Transit Association, Bus Capital Needs (November 19, 1981).

17. See, for example, Institute of Public Administration, Financing Transit: Alternatives for Local Government (July 1979), prepared for U. S. Department of Transportation, pp. 9-10.

waste energy, in large part because most new riders come from relatively more fuel-efficient buses or carpools rather than from single-occupant cars. 18/ Finally, mass transit's benefits to disadvantaged groups, such as the poor, the elderly, and the disabled, are often taken for granted. Though this assumption appears valid for highly specialized public transportation services, such as "dial-a-ride" vans, most forms of mass transit serve predominantly higher-income persons of working age. 19/

Correcting for these analysical shortcomings, CBO's reestimates of projected mass transit needs suggest that annual total transit capital requirements over the next decade could be as low as $3.6 billion. This is $1.9 billion less than the $5.5 billion reported by UMTA and APTA together (see Table III-3). The major reason underlying this marked discrepancy is a different view of the effectiveness of new rail transit systems. In addition, several years of planning and detailed engineering work usually precede the start of construction. Thus, federal financing will not be committed immediately but will be phased in over a period of years. Assuming that the current 75 percent cost-sharing arrangement were continued and that all transit projects were financed at that ratio, the annual federal investment in mass transit would range from $2.7 billion to $4.1 billion. The difference would depend on whether a low or high estimate of needs prevailed.

Even a more moderate estimate need not be equated with required federal assistance. All benefits from mass transit are local. Therefore, the justification for federal assistance--especially for projects with large initial capital costs that are far beyond local financing resources--must rest with a federal decision to assist urban areas.

## FEDERAL STRATEGIES TO IMPROVE PUBLIC TRANSIT INVESTMENT

Rather than increase federal funding by the 10 percent needed to meet the higher estimate of needs--that is, $400 million in addition to the current

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18. See Congressional Budget Office, Urban Transportation and Energy: The Potential Savings of Different Modes (December 1977). Extensions of existing systems do, however, appear to offer some energy-saving potential.

19. See Robert B. Cervero and others, Efficiency and Equity Implications of Alternative Transit Fare Policies (September 1980), and Congressional Budget Office, Urban Transportation for Handicapped Persons: Alternative Federal Approaches (November 1979).

$3.7 billion--the Congress could consider revising those features of the current grant system that tend to promote inefficient investment. This section reviews several options that, by improving the targeting of federal dollars, might help meet current and future demand for capital investment. These options include reducing the federal match for transit capital grants, redesigning grant allocation formulas to improve targeting, providing alternative financial mechanisms, and encouraging cost-effective innovative modes of operations.

## Reducing the Federal Match

For most urban areas, access to the current 75 percent federal match strongly influences local decisions in favor of capital-intensive transit projects. A more limited federal match on UMTA capital grants--60 percent, for example--would help return priority-setting for transit development to the local level, where needs can often be assessed most accurately. Though still offering substantial federal assistance for capital-intensive projects, a 60:40 federal:local matching ratio would encourage localities to commit funds only to projects they really need, and to make better decisions regarding the trade-off of improved service versus reduced fares. For example, more attention might be focused on the fact that service improvements attract more riders than do fare reductions. In general, localities would be encouraged to serve such basic objectives as cost effectiveness in moving large numbers of people, rather than build capital-intensive projects made attractive by generous federal funding.

At the current level of spending, reducing the federal match to 60 percent would save the federal government $0.7 billion a year. In fact, a much greater reduction could be realized, since the increase in the nonfederal share (from the current 25 percent to 40 percent) would probably stimulate serious reevaluation of many projects and cancellation of some. A 60 percent federal share of the high estimate of transit needs would require $3.3 billion a year (see Table III-4), slightly less than current federal funding levels. On the basis of the lower estimate of needs, however, only $2.2 billion would be required, which could permit elimination of the recently imposed 1-cent-per-gallon tax on motor fuel.

## Redesigning Grant Allocation Formulas

Use of mass transit, and the consequent need for capital expenditures, is concentrated in a small number of urban areas. Federal spending, on the other hand, is dispersed widely. As a result, the highest priority projects are not always funded.

TABLE III-4. FEDERAL INVESTMENT IN MASS TRANSIT BASED ON LOW ESTIMATE OF NEEDS, 1983-1990
(In millions of dollars)

| Category and Program | Current Spending a/ | Annual Needs With Low Estimate | Federal Share of Low Estimate | |
|---|---|---|---|---|
| | | | Current Policy | 60 Percent |
| | REPAIR, MODERNIZATION, AND REPLACEMENT | | | |
| Bus Rehabilitation and Replacement | 1,223 | 610 | 458 | 366 |
| Bus Maintenance Facilities Modernization | | 340 | 255 | 204 |
| Rail Rolling Stock Replacement and Modernization | 1,250 | 250 | 188 | 150 |
| Track and Signal Improvements | | 1,200 | 900 | 720 |
| Rail Maintenance Facilities Modernization | | 500 | 375 | 300 |
| Subtotal | (2,473) | (2,900) | (2,175) | (1,740) |
| | ADDITIONAL CAPACITY | | | |
| Rail System Extensions | 534 | 500 | 375 | 300 |
| New Rail Systems | 664 | 200 | 150 | 120 |
| Subtotal | (1,198) | (700) | (525) | (420) |
| Total Costs | 3,671 | 3,600 | 2,700 | 2,160 |

SOURCE: Congressional Budget Office from data in Table III-3.

a. Preliminary. Includes $1.1 billion from the 1-cent-per-gallon fuel tax. This sum has been allocated in proportion to previous grants from Section 3 of the Urban Mass Transportation Act of 1964.

The current formula for bus replacement, for example, emphasizes population size and density, but neither factor gives a good indication of bus replacement needs. Though the formula was modified in 1982 to include bus miles, it still does not take into account local financial effort or system performance. In fact, the formula treats efficient and inefficient systems identically. Distribution formulas could be redesigned to reward efficiency and to target the greatest resources to areas whose needs are greatest. 20/ As an example, a revised formula could be based on number of passengers or passenger miles; this would allow federal grants to be set in proportion to direct measures of demand.

## Block Grants

One way to help correct distortion of local priorities brought about by federal policies would be to consolidate further the assorted transit grant programs into unified block grants. (The current formula-based funding is already a form of block grant.) In general, block grants carry relatively few federal conditions, and they can avoid much cumbersome administrative overhead. In transit, they could be distributed according to revised formulas as discussed above, allowing size of federal assistance to be tailored to urgency of need in terms of both function and locale. If the grants were made available for operating purposes as well as capital needs, then a cap on the amount to be used for operating assistance might be stipulated to encourage a balanced use of federal funds and discourage a return to the practice of deferred maintenance. 21/

## Innovative Operations

In recent years, an array of innovative alternatives to conventional, fixed-route bus and rail systems have developed to reduce costs and mesh the operating characteristics of urban transit with the changing needs of urban and suburban riders. For example, private taxicabs for shared-ride operations, small buses (jitneys) on irregular routes, and reservation van

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20. For a preliminary calculation of each urban area's allocation under several alternative formulas, see Congressional Budget Office analysis in Oversight Committee of House Committee on Public Works and Transportation, Oversight of the Federal Public Transportation Assistance Program (May 1982), Appendix B, pp. 33-40.

21. See discussion of the block grant concept in Oversight of the Federal Public Transportation Assistance Program (May 1982), pp. 23-26.

pools for travel to and from specific work places and shopping centers have proven cost-effective substitutes for conventional services. 22/ In addition, these innovative operations have proven the most effective method for providing transit to meet the special needs of persons who are dependent on public transportation, such as the poor, the elderly, and the disabled. 23/

Although proposals with considerable potential for improved cost effectiveness exist, a number of regulatory barriers inhibit their introduction beyond the experimental phase. For example, the cost effectiveness of private taxicabs under contract to transit operators hinges on the fact that most taxicab personnel are not unionized. But under current federal law, transit authorities can be made to pay union-level wage rates in contracting with such companies. 24/ The local regulation of who can offer transit services and how rates are set also inhibits innovation in transit operations. Relaxation of these and other regulatory strictures could encourage transit operators to implement readily available transit innovations.

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22. See Ronald Kirby and others, Para-Transit: Neglected Options for Urban Mobility (1978), the Urban Institute.

23. See Congressional Budget Office, Urban Transportation for Handicapped Persons.

24. Section 13(c) of the Urban Mass Transportation Act of 1964.

## CHAPTER IV. WASTEWATER TREATMENT

*Inadequate sewer pipes and sewage treatment as well as insufficient system capacity to handle storm runoff characterize many of the nation's 15,000 wastewater treatment systems. If uncorrected, these problems could compromise federally mandated ambient water quality standards. Costs to meet wastewater treatment needs are estimated by the Environmental Protection Agency to total $118 billion by the year 2000, but projected federal and nonfederal outlays combined fall short of that goal by about 24 percent. The federal role in financing a major share of wastewater treatment has already begun to decline under recent legislation from 75 percent of capital costs since 1972 to 55 percent in 1985. To compensate for near-term losses and longer-term reduction of federal support prompted by budgetary strictures, local wastewater authorities, assisted by states, could step up efforts already under way to explore other public and/or private financing sources. Further, federal regulatory measures governing wastewater treatment might in certain instances be waived at no risk to natural water quality.*

### THE PROBLEMS IN WASTEWATER TREATMENT

Traditionally, the provision of wastewater treatment has been almost solely a nonfederal responsibility, with the states and localities operating and financing the nation's treatment systems. In the early 1970s, public concern over the declining condition of the nation's natural waterways prompted the federal government to assume a greater role. That part, which began very small and has since increased markedly, now provides partial financing and technical assistance to localities in support of local operation and maintenance of sewage treatment facilities. Late in the decade, the states too became involved in the funding of local wastewater treatment facilities.

Three types of physical problems in the nation's wastewater systems are evident: leaking, blocked, or undersized sewer pipes; undersized or inoperative treatment facilities; and facilities that cannot handle storm water. In some places, treatment facilities simply do not exist. The

Environmental Protection Agency (EPA) assesses capital needs of publicly owned treatment works every two years partly on the basis of reports of physical condition; EPA evaluations provide the basis of this analysis. The EPA's estimate of needs attests to the pervasiveness of physical problems.

A study of 28 cities conducted in 1980 for the Urban Institute found that system failures were concentrated in the older cities of the Northeast, Midwest, and South. 1/ But age alone was not the cause of most failures; rather, infrequent maintenance was the direct cause most commonly identified. For example, the new and modern system in San Jose, California had the second highest rate of stoppages of all cities studied. Officials in San Jose claimed that this high failure rate reflected low system maintenance.

Another indicator of the physical integrity of wastewater conveyance systems (collectors) is infiltration and inflow (referred to as I/I), which can result in high treatment costs. Infiltration is groundwater that seeps into sewer pipes through cracks and loose joints. Inflow is the water entering sewer pipes from heavy rainfall. As a collector system cracks or separates at pipe joints, levels of I/I rise. In the EPA's 1980 Needs Survey, the agency found that, of the 19,000 treatment plants and collector systems assessed, about 16 percent, or 3,000 plants, had significant I/I problems amounting to about 25 percent of total flow. 2/ To translate that rate into practical terms, communities were treating as much as one-third more wastewater than they needed to because of cracked or loosely fitting sewer pipes.

To meet the statutory mandate of the Clean Water Act (Public Law 92-500), the EPA estimated that, as of 1980, about 8,000 facilities, or about half of all existing sewage treatment plants, would need enlarging, upgrading, or replacing. 3/ Every state has some such needs, and requirements for upgrading generally correspond to population, with New York accounting for 19 percent of total U.S. expansion needs, California for 9 percent, Florida for 7 percent, and Pennsylvania for 6 percent.

Communities in 40 states have combined sewers designed to collect storm runoff as well as wastewater. During heavy rain, these sewers can back up, causing basement flooding. They can also overload treatment plants, causing raw waste to be discharged to receiving rivers, lakes, and

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1. See Nancy Humphrey and Peter Wilson, Capital Stock Condition in Twenty-Eight Cities, Urban Institute (February 15, 1980).

2. See Environmental Protection Agency, The 1980 Needs Survey--Summaries of Technical Data (February 10, 1981), Table 49.

3. See Environmental Protection Agency, 1980 Needs Survey, Table 3.

streams. This problem is present in 34 of the 40 states with communities served by combined sewers, and it is most acute in Illinois, Indiana, Michigan, New York, Ohio, and Pennsylvania. 4/

## Costs of Deferred Maintenance

Not maintaining sewer systems and treatment plants can exact high costs from both users and the economy in general. When regular maintenance is neglected, user-borne costs include increased sewer fees (from I/I flow and poorly operating treatment plants) and increased capital outlays for major rehabilitation. Of 126 Wisconsin collector systems studied, for example, 84 percent of the total wastewater flow delivered to the treatment plants was I/I flow, not wastewater. Such a high proportion of I/I flow could increase users' costs by as much as 500 percent. Though this example may be extreme, I/I problems of some magnitude exist in all states. 5/

The general economic toll includes the costs of street repair caused by failing sewer pipes, the additional economic costs of degraded water received downstream of a failing treatment plant (such as additional treatment to render river water potable in a downstream community), and economic losses associated with fish kills or low fishery productivity caused by polluted water. In an area that does not provide adequate wastewater treatment, economic costs can also take the form of lost industry, commerce, and residential development.

## CURRENT POLICY IN WASTEWATER TREATMENT

Federal involvement in funding wastewater treatment facilities began in 1957 under the U.S. Public Health Service (PHS). Between 1960 and 1966, only about $200 million a year in direct expenditures went toward wastewater treatment grants to states. In 1966, the PHS wastewater treatment grants program was transferred to the Department of Interior, and in 1970, it was again transferred to the then new Environmental Protection Agency. Wastewater facilities grants have been available under two other federal programs since the 1960s and 1970s--one administered by the Economic Development Administration (EDA) beginning in 1965, and another by the Department of Housing and Urban Development (HUD)

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4. See Environmental Protection Agency, 1980 Needs Survey, Table 54.

5. See Environmental Protection Agency, 1982 Needs Survey--Cost Estimates for Construction of Publicly Owned Wastewater Treatment Facilities (December 31, 1982).

beginning in 1975. In the early 1970s, improving water quality became a national priority because of rapidly degrading waterways and heightened public awareness.

## The EPA Municipal Wastewater Program

Since 1970, by far the most important wastewater treatment program has been the wastewater facilities grants program under the EPA, accounting for about 85 percent of all federal wastewater spending (see Figure IV-1). 6/ The EPA's outlays for wastewater facilities grants more than doubled between 1971 and 1974, from $1.1 billion to about $2.9 billion. Between 1975 and 1982, the EPA made between $3 billion and $5 billion in wastewater facilities grants a year. Under this program, the EPA now pays 75 percent of the capital costs of constructing or improving conventional publicly owned treatment works, or 85 percent for so-called "innovative" technologies. 7/ Beginning with fiscal year 1985, the federal share under this program will be reduced to 55 percent of capital costs for conventional systems and 75 percent for innovative systems. Project grants are available to states according to an allocation formula based on population and the EPA's assessment of needs. Local recipients of EPA grants are responsible for paying all operation and maintenance costs.

## State and Local Spending

State aid to local government for financing wastewater facilities is relatively new. It began in 1978, when all states combined spent about $400 million for this purpose. But by 1981, 41 states had established some sort of program extending grants (32 states) and/or loans (13 states) to localities to help them meet the 25 percent local share of capital costs required under the EPA's 75 percent matching program. Most local jurisdictions finance the remaining capital portion of wastewater facilities by issuing revenue

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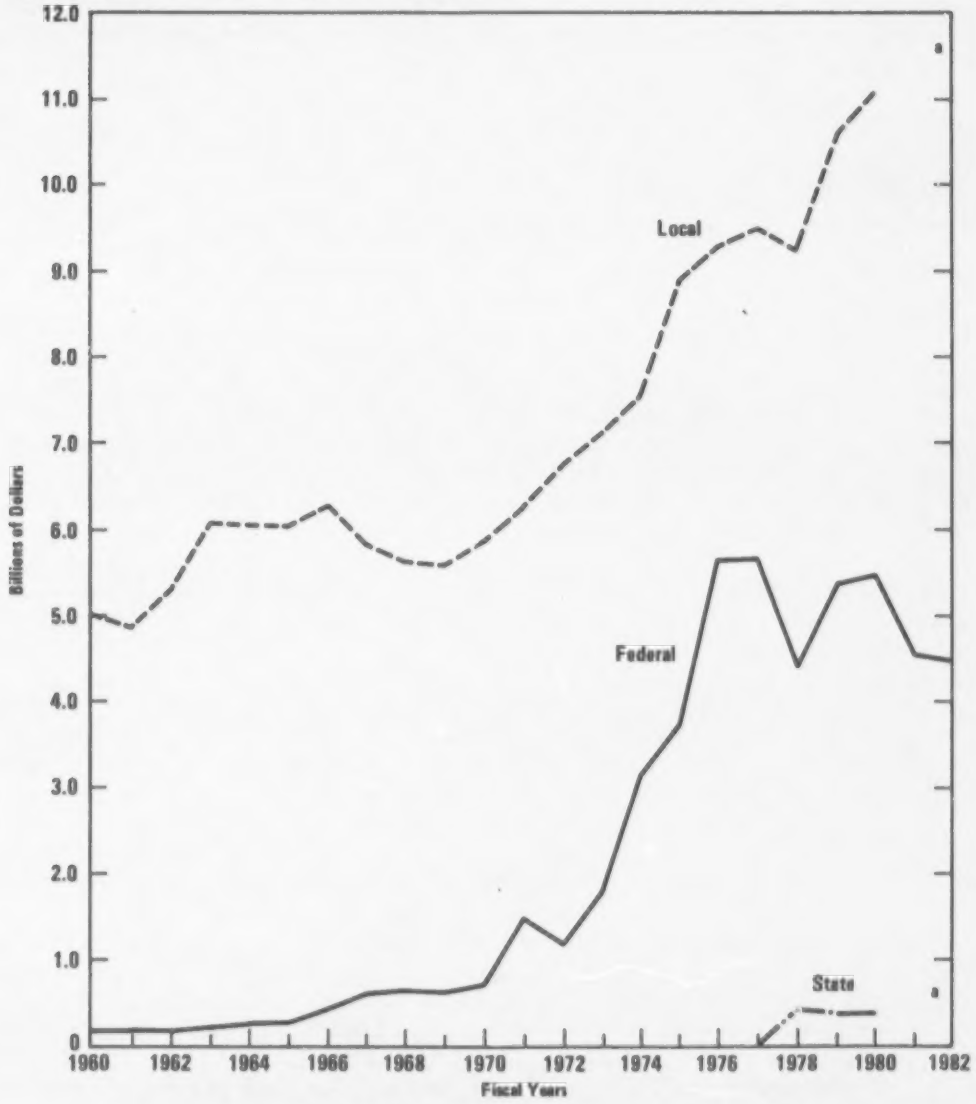
6. These grants were authorized under section 201 of the Federal Water Pollution Control Act of 1972 (P.L. 92-500).

7. Under provisions of the Clean Water Act, both "innovative" (new and unproven) and "alternative" (proven in practice) technologies qualify for the higher federal share. These technologies may be more cost effective than conventional collection and treatment systems, particularly for small or rural communities. For example, alternative treatment processes include land application of wastewater or processes that reclaim or reuse wastewater.

Figure IV-1.

## Federal, State, and Local Spending for Wastewater Services, 1960-1982




SOURCE: Congressional Budget Office from data provided by the U.S. Environmental Protection Agency and the U.S. Department of Commerce, Bureau of the Census.

[a] Actual state and local data for 1980-1982 not available.

bonds and imposing on users the costs of operation, maintenance, and repayment of debt. Throughout the 1960s and early 1970s, local jurisdictions spent between $5 billion and $6 billion a year on wastewater treatment (capital plus operation and maintenance expenditures). But in 1973, in response to the EPA's grant program, local spending increased dramatically. In the late 1970s, total local spending on wastewater treatment (including EPA capital grants, passed through states to localities) increased about 7 percent a year, from about $7 billion in 1973 to $11 billion in 1980.

## Major Needs

The needs estimates for wastewater systems' capital improvements are based on achieving water quality goals stipulated in the Water Pollution Control Act of 1972 and in subsequent amendments (Clean Water Act of 1977 and Municipal Wastewater Treatment Construction Grant Amendments of 1981). These acts mandated, at a minimum, construction of "secondary" wastewater treatment facilities for all publicly owned wastewater treatment plants by a set date. [8] The 1981 amendments shifted federal spending priorities. They extended the deadline for secondary treatment or better from 1983 to 1988, expanded the definition of eligible secondary treatment processes, limited new treatment plant sizing to current populations, and made fewer needs categories eligible for federal grants.

In 1982, the EPA estimated that, by the year 2000, about $118 billion would be needed to provide wastewater collection systems, install secondary treatment facilities (or better in some instances), correct I/I problems, replace or rehabilitate malfunctioning sewer pipes, and correct storm water problems for all publicly owned wastewater treatment systems. [9] Given the current federal share, and with needs distributed uniformly over 18 years, the federal government would have to spend about $5.1 billion a year in 1983 and 1984 and $3.9 billion each year between 1985 and 1990 to meet

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8. Secondary treatment generally includes mechanical and biological processes to remove 85 percent of solid matter and organic oxygen-demanding substances; effluents are also chemically disinfected before discharge.

9. See Environmental Protection Agency, 1982 Needs Survey. Estimates were based on population, projected flows, and engineering cost estimates derived from past experience. The EPA projected needs in eight categories (three levels of treatment, four types of sewer pipe needs, and combined sewer overflow needs). About half of total needs were estimated by reliable techniques according to the EPA.

all identified needs (about $4.2 billion each year, on average). 10/ On the basis of estimated 1983 outlays, this represents about a 31 percent increase in annual federal spending for wastewater through 1984. To match federal spending, state and local governments combined would have to spend about $1.5 billion a year in 1983 and 1984 and about $2.7 billion in each year between 1985 and 1990. In 1985 and thereafter, states and local jurisdictions combined would have to double their current capital spending to meet these projected needs.

But "needs," as interpreted by the EPA in terms of meeting the goals of the Clean Water Act, are based on a fixed national standard for wastewater treatment. This implies bringing effluent to a certain minimum quality before it can be discharged. In two situations, the EPA's interpretation may be causing overinvestment: where a lesser quality effluent will not result in a degraded environment (such as in some coastal areas), and where secondary or better treatment still does not result in clean water (such as in waterways degraded by causes other than wastewater).

## EFFICIENCY OF CURRENT FEDERAL WASTEWATER PROGRAMS AND STRATEGIES FOR IMPROVEMENT

Benefits of wastewater collection and treatment systems accrue both to primary users and to downstream communities. Building adequate facilities solves local wastewater collection and water quality problems; but clean water also benefits other parties downstream who pay nothing for it. Because of this, no single community would be willing to charge its residents the full cost of wastewater treatment. Consequently, the responsibility for maintaining high quality rivers, lakes, and streams is shared both by direct users and by all levels of government. A federal role that maintains both the current level of participation and the current rate of spending will fall short of fully meeting wastewater treatment needs, as defined by the EPA standards. In light of the Congress' commitment to restrain the growth of federal spending, legislators may want to consider measures that would improve the cost effectiveness of spending without raising the level.

Several strategies are available for improving the efficiency of current spending. The mechanisms of current clean water policy leave room for possible economies. In effect, the Clean Water Act mandates use of certain costly technologies to meet water quality standards. In many instances, these processes are the only means by which wastewater treat-

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10. The federal share prior to 1985 was 75 percent of capital costs, dropping to 55 percent in 1985. This estimate neglects a higher federal share if innovative systems are funded.



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ment plants can achieve EPA standards. In other cases, a secondary level of treatment is not essential, however. At times, water quality is more directly linked to sources of pollutants other than wastewater--soil erosion, for example. In these cases, capital-intensive wastewater treatment may not improve water quality. Elsewhere, natural processes, such as mixing, dilution, and bacterial decomposition, can make expensive treatment unnecessary. More flexible regulations that could be adaptable to local water quality or hydrological conditions could allow wastewater treatment needs to be met at a lower cost. In addition, Congressionally enacted block grants might provide federal assistance more efficiently than do the current project grants. Where federal funds are not sufficient to meet local needs, alternatives would be available to states and localities to help finance wastewater treatment projects. Finally, private financing or ownership might help relieve local jurisdictions of the burdens of capital formation.

## Current Policy

Under the appropriations ceilings now authorized, the EPA and other federal agencies will spend an average of $3.2 billion on wastewater facilities each year between 1983 and 1990 (see Table IV-1). 11/ To match these federal grants, states and localities will spend about $1.8 billion a year over the same period. Assuming annual requirements of about $6.6 billion per year (from the EPA's needs survey), about $1.6 billion in annual needs, or 24 percent, would remain unmet under present policy. To meet all needs as estimated by the EPA, federal spending under current matching ratios would have to increase to an average of $4.2 billion each year between 1983 and 1990. Federal spending could be increased to $3.7 billion a year (the midpoint between meeting all needs with higher federal spending and spending under currently authorized federal ceilings). This would leave the rest to be met by applying other strategies.

Effects of Increasing the Nonfederal Share. The currently planned increase in the nonfederal share from 25 percent to 45 percent in 1985 stands to affect two groups of communities more severely than all others: smaller communities (less than 10,000 in population) and older, financially distressed urban centers. In a review of the facilities grants program in 1981, the EPA noted that per capita treatment costs, under a 25 percent nonfederal share, were significantly higher for small communities. The causes identified were small-sized plants that failed to realize economies of scale and the relatively high costs of collecting wastewater from small

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11. Municipal Wastewater Treatment Construction Grant Amendments of 1981 authorized appropriations at $2.6 billion a year through 1985. Estimate assumes continued authorizations through 1990.

TABLE IV-1. ESTIMATED FEDERAL AND NONFEDERAL CAPITAL OUTLAYS FOR WASTEWATER FACILITIES UNDER CURRENT POLICY (In billions of dollars)

| Funding Source | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | Annual Average |
|---|---|---|---|---|---|---|---|---|---|
| EPA a/ | 3.4 | 2.8 | 3.0 | 2.7 | 2.4 | 2.5 | 2.5 | 2.6 | 2.7 |
| Other Federal b/ | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Nonfederal | 1.1 | 0.9 | 2.5 | 2.2 | 1.8 | 2.0 | 2.1 | 2.1 | 1.8 |
| Total | 5.0 | 4.2 | 6.0 | 5.4 | 4.5 | 4.9 | 5.1 | 5.2 | 5.0 |

SOURCE: Congressional Budget Office.

a. Assumes 1985 level of EPA appropriations authorization ($2.6 billion) for 1986 through 1990.

b. Includes FmHA and HUD grant and loan program outlays at a constant 1982 level.

dispersed populations. 12/ Besides supporting lower per capita incomes, most smaller cities have lower bond ratings, and consequently must pay proportionately more to borrow money.

Many financially distressed older cities accounted for the highest per capita needs in the EPA needs survey. In the Urban Institute's study of 28 large cities, a strong correlation was noted between high per capita needs, low fiscal capacity, and declining sewer maintenance expenditures attributable to financial pressures. 13/

## Increased Flexibility in Meeting Federal Regulatory Requirements

In certain instances, as noted above, economies could possibly be achieved by a relaxation of the federal regulations that prescribe the way in

12. See Environmental Protection Agency, 1990 Strategy for Municipal Wastewater Treatment-Funding (January 1981).

13. See Humphrey and Wilson, Capital Stock Condition, pp 12-14.

which wastewater treatment authorities meet clean water standards. Current policies allow little latitude in this area.

Costly wastewater treatment can be futile where external agricultural, industrial, or natural causes impair water quality. In rural communities, for instance, river or stream water may be so degraded by causes unrelated to wastewater or its treatment--soil erosion, phosphorus and nitrogen runoff from fertilizers, or chemical contamination from pesticides--that treated wastewater is in fact much cleaner than the natural waterways it empties into. Intense farming or natural erosion upstream from an urban area may so dominate natural water quality that secondary and advanced treatment systems have little measurable influence on river or stream quality. Minneapolis-St. Paul and St. Louis are typical examples of cases in which millions of dollars have been spent to reduce discharges, yielding little improvement in river water quality. In Pennsylvania, acid drainage from coal mines has degraded several thousand miles of streams, some of which now cannot support aquatic life. Such examples suggest that local waivers of strict national treatment standards might reduce treatment costs without further degrading water quality.

Where wastewater empties into coastal water, wastewater discharges might be allowed after only limited treatment. In some coastal systems, natural currents cause mixing, dilution, and biological decomposition of waste so that, in the discharge area, environmental degradation does not result and healthy biological communities thrive. Again, making waivers available rather than adhering rigidly to secondary treatment guidelines might make economic sense. In a recent study, the General Accounting Office estimated up to $10 billion could be saved by granting such secondary treatment waivers to 800 coastal communities. 14/ This estimate includes all possible applications; in some locations, such waivers might cause environmental degradation. Situations would differ, of course, and the costs and benefits would have to be evaluated case by case.

The EPA has identified about $5.7 billion in needs for removal of pollutants beyond secondary treatment levels, suggesting a need for advanced wastewater treatment (AWT) in places where such removal would help achieve ambient water quality standards based on designated use. 15/

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14. See General Accounting Office, Billions Could Be Saved Through Waivers for Coastal Wastewater Treatment Plants (May 22, 1981).

15. AWT removes up to 99 percent of solid matter, bacteria, and organic oxygen-demanding pollutants. In addition, higher levels of nitrogen and phosphorus are removed by adding chemical and physical processes not used in typical secondary treatment plants.

Beyond the level of 85 percent removal, the costs per unit of pollutant removed by secondary treatment increase dramatically, and these high marginal costs may not be justified on the basis of marginal water quality benefits. Where receiving streams are already degraded by agricultural residues, making communities pay high premiums to remove those substances from a wastewater discharge may not be appropriate. In Sac City, Iowa, for example, an AWT project approved for federal financing has been initiated to remove ammonia from the city's discharge, even though, since 1971, no ammonia levels attributable to Sac City's effluent have violated present water quality standards. Valued sport fish--smallmouth bass and walleye, which abound in clean water--already inhabit the receiving stream in Sac City. Between 1980 and 1982, an EPA program for reviewing AWT needs saved $300 million by reconsidering site-specific water quality and potential improvements of advanced treatment; if the EPA continues this practice, even more could be saved.

Savings to the Federal Government. Although estimating the exact savings or reductions in need following from more flexible regulations is difficult, perhaps 5 percent of the secondary treatment needs, one-third of the AWT needs, and half of the potential coastal waivers might be realized as savings. Together, these amount to about $8 billion in savings over 20 years, or a yearly reduction in total wastewater needs of about $420 million (6 percent). To guard against environmental degradation resulting from relaxed regulations, waivers could be thoroughly evaluated during EPA's normal Environmental Impact Study process.

## Block Grants

Instead of disbursing funds on a project-by-project basis, a shift to federal block grants to states for water pollution control might reduce overall administrative costs. Block grants could be distributed among states on the same basis used to allocate project grants--that is, according to a formula that reflects population and EPA's assessment of relative need. Only 56 block grants (to the 50 states, the District of Columbia, and five territories) would be made each year, as opposed to some 500 to 700 project grants made each year under the current distribution system. Although some of the costs of disbursing and auditing project funds would be transferred to the states, if this arrangement had been in effect during fiscal year 1981, perhaps $10 million in federal administrative costs could have been reallocated to direct federal aid.

Block grants would also give the states more leverage and discretion in disbursing their allotted funds. In New Jersey, for example, the Governor recently announced that his state would like to use federal capital grants

combined with state bond proceeds to make low- or no-interest loans to municipalities through a new Infrastructure Bank. Under this block grant approach, the state of New Jersey estimates that some 200 treatment systems could be upgraded rather than the 11 now possible under EPA project grants. 16/

One result of a block grant approach, however, would be that the municipalities receiving loans would end up paying higher user fees than they do now. According to an initial state of New Jersey estimate, user fees would increase by some 30 percent. 17/

## Alternatives Available to the States

State and local authorities are already exploring nonfederal financing sources in anticipation of the scheduled reduction in federal matching share to be effective in 1985. These jurisdictions could expand such efforts to compensate for funding lost to a diminished federal role. Money from various sources, packaged into what has come to be called "creative financing solutions," may be available to help states and localities prevent federal cuts from translating into serious degradations of water quality. A higher nonfederal share almost certainly would mean increased user fees, however.

Many states have recently established bond banks, for example, to assist local communities. 18/ Under this arrangement, a state buys local revenue bonds, repackages them, and sells them as state revenue bonds at lower interest rates than local bonds would have received. The net effect is

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16. See Joseph F. Sullivan, "Kean Seeks Agency to Help Maintain Roads and Sewers," The New York Times (October 4, 1982).

17. Though a 30 percent increase is perhaps high compared to fees under direct EPA project grants, the estimate does not consider potential efficiency gains that would be promoted by local jurisdictions under higher user fees. Downsizing plant components and substituting more efficient technology could result in a smaller increase in user fees than might be expected.

18. In 1982, seven states operated bond banks for water development: Alaska, Idaho, Maine, New Hampshire, Nevada, North Dakota, and Vermont. For additional details, see Robbi J. Savage, State and Local Roles in Funding Clean Water, report prepared by the Association of State and Interstate Water Pollution Control Administrators for the Lincoln Institute of Land Policy (October 1982).

a lower cost to users for raising development capital. Some states also offer local jurisdictions bond insurance or bond guarantees, which can lower borrowing costs as well.

Several other options are available that increase marketability of local bonds. These include mini-bonds, which are small-denomination, tax-exempt bonds sold to local citizens; 19/ innovative bonding (zero-coupon, variable-rate, put-option, bonds with warrants); and short-term debt, which includes tax-exempt commercial paper; and tax-anticipation notes.

Using only local funds to finance new low-cost technology is another option that has become increasingly attractive. In the case of four Pennsylvania municipalities that constructed wastewater treatment facilities solely with local funds, both construction and maintenance costs were reduced to about half the equivalent project costs of conventional federally funded projects. 20/ In Medford, Oregon, a locally funded plant cost an estimated $18 million less than the estimated cost under the EPA program. 21/ One source of savings would stem from avoiding the administrative overhead that usually prolongs federally funded projects from two to about eight years. In the case of the four Pennsylvania municipalities, the project took only 19 months from design through start of operations. Second, genuinely innovative technologies could be used, though these might not meet EPA guidelines, to achieve final effluents that do meet all federal and state standards.

## Involving the Private Sector

From the standpoint of municipal governments, involving the private sector--either in financing or in ownership of wastewater treatment facili-

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19. In a four-month period in 1978, East Brunswick, New Jersey, a community of 33,000, issued $1 million worth of mini-bonds. Prompted by that success, Massachusetts, Oregon, and several other states authorized localities to issue mini-bonds.

20. The municipalities were Carlisle, Hampden, Hatfield, and Ephrata. For additional details, see Tracey W. Greenlund, Low Load Aeration Process Design Theory, Tracey Engineers, Inc., Camp Hill, Pennsylvania (1982).

21. See U.S. House of Representatives, Committee on Public Works and Transportation, Subcommittee on Oversight and Review, Implementation of the Federal Water Pollution Control Act (December 1980).

ties--can relieve local jurisdictions of the burden of capital formation while allowing a reasonable rate of return to investors. But from the federal perspective, it is questionable whether so called "backdoor" subsidies--investment tax credits, rapid depreciation provisions 22/--and low interest rates available on municipal bond issues are the most efficient way of helping local jurisdictions raise development capital. Some analysts of "privatization" through tax subsidies claim that direct interest subsidies to municipalities would be the more efficient of these two courses. 23/

Two types of privatization are feasible: private financing of facilities and public operation under a lease-back provision; and private ownership and operation. The former arrangement may be preferable to city officials, who may want to retain control of their municipal facilities; the latter may be preferable to private industry, because corporations can take full advantage of all tax benefits if facilities are privately owned and operated. Some private-sector representatives have expressed skepticism of partnership arrangements with local government, fearing project delays and the higher costs typical of public involvement. 24/ Moreover, under private ownership and public leaseback schemes, investment tax credits are no longer available to the private owner, which reduces the profitability of such arrangements.

Two types of private ownership and operation arrangements may be feasible. The first would require that a municipality or other public authority issue an industrial development bond to raise capital to finance the facility. These are municipally issued bonds that are tax exempt when used to finance private development of wastewater treatment facilities. The authority deposits the bond proceeds with a bank and receives a certificate of deposit in return. The interest the bank pays equals the certificate-holding authority's interest obligation to the bondholders. The certificate, plus the standard federal deposit insurance available through banks, is used to guarantee the bond, ensuring a good rating and a low interest rate. The bank then contracts with a private company to construct and operate the wastewater facility under an operation and maintenance

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22. Made available under the Economic Recovery Program Tax Act of 1981.

23. See, for example, Congressional Budget Office, Reducing the Deficit: Spending and Revenue Options (February 1983), pp. 283, 310.

24. An example comes from personal communication with Harvey Goldman, partner, Arthur Young and Company, New York, New York (November 9, 1982).

contract. The bank receives investment tax credits, depreciation benefits, and lease payments from the private company. The municipality gets wastewater treatment user fees that are lower than if it financed the facility directly (because of the value of the certificate and insurance as a guarantee). In addition, the municipality's risk in the bond market is reduced. The private company makes money on the difference between user fees and lease payments to the bank.

This arrangement was devised to finance solid waste disposal projects, but it has not yet been tried for a wastewater project. 25/ Several questions remain, including the propriety of using federal deposit insurance to guarantee bonds and the tax-exempt treatment of bonds used for this purpose. 26/ Finally, whether direct interest subsidies to municipalities would be more cost effective than "backdoor" subsidies to private industry is unclear.

Private ownership and operation of wastewater facilities might be profitable without industrial development bonds. The combination of accelerated depreciation (five years on equipment, 15 years on real property), a 10 percent investment tax credit, interest deductions on privately raised capital, and collection of user fees might provide sound investment packages for private-sector investors.

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25. Personal communication with Robert Price, partner, Pepper, Hamilton, and Scheetz, Philadelphia (December 8, 1982).

26. Though currently legal, legislation has been introduced (H.R. 1635, introduced by Representative Pickle on February 24, 1983) that would make illegal the use of federal deposit insurance to lower bond ratings. The Office of Management and Budget has prevented this practice in the past under its administrative authority, but new statutory authority now appears required to prevent future use of the practice.

## CHAPTER V. WATER RESOURCES--MULTIPURPOSE DAMS AND NAVIGATION WORKS

*Needs for investment in water resources are divided roughly evenly between efforts that would prolong the useful lives of numerous dams and navigation works and those that would provide new or replaced capacity. On the basis of estimates by the U.S. Army Corps of Engineers, which builds and maintains multipurpose dams and a large share of all navigation works, the CBO estimates annual federal costs to meet water resources needs to be about 60 percent higher than current spending, going from $2.3 billion to $3.7 billion each year between 1982 and 1990. To meet total needs--about $4.1 billion a year--states and local governments would have to spend an additional $400 million a year. Backlogs of projects that have been approved but not begun have compounded these needs. CBO analysis concludes that needs estimates may be exaggerated, finding the federal role in financing (nearly 100 percent) and paying (roughly 70 percent) for these services one likely cause of overstatement, along with nonfederal financing shares that may be too small, and undercharges to users. Adjustments in the current allocation of costs, entailing realignment of responsibilities among levels of government, intergovernmental grants or loans, and major increases in user fees, could help contain increases in federal costs, holding them perhaps at $3.1 billion a year, or about 35 percent above current federal spending.*

### THE PROBLEMS IN WATER RESOURCES

The federal government, largely under the auspices of the U.S. Army Corps of Engineers, plays a dominant role in building and maintaining the nation's water resources public works--navigational canals, locks and dams, ports, and multiple-purpose dams. (Multipurpose dams generally impound river water to serve several functions including flood control, irrigation, navigation, hydroelectric power generation, municipal and industrial water supply, and recreation.) In keeping with this major role, the Corps of Engineers is also the main source of information on water resources needs.

## Inland Waterways

The Corps of Engineers has concluded that many U.S. canals, locks, and dams are past the end of their design lives and need systematic maintenance and rehabilitation. Such manifestations of neglect can interfere with the efficient use of these facilities. 1/ Of the 194 locks in the inland waterway system, the average age is 40 years, and some locks are approaching 80 years of service. A 50-year service life is generally considered the limit for safe and efficient operation of navigational locks. The corps estimates that reconstruction or rehabilitation of 37 locks would have to be initiated between 1981 and 1990 to maintain navigational efficiency and safety. Construction of these facilities would be finished between 1995 and 2000, at an estimated total cost of about $5.4 billion.

## Ports and Harbors

Over time, dredged ports and harbors naturally lose depth as silt and other material deposited by wave and current action and inflowing rivers cause their floors to rise. The Corps of Engineers reports that, besides routine dredging to maintain present depths, major dredging will be needed to deepen three important ports--Baltimore, Norfolk, and Baton Rouge. That deepening will be needed to accommodate expanding export shipping, particularly of coal. Today's largest coal-carrying ships (super-colliers) require port depths of 55 feet or more; most U.S. coal ports have average depths of 45 feet. Though deepening three ports may reflect overoptimism about U.S. trade prospects in view of the fact that foreign demand for U.S. coal has recently subsided, deepening at least one coal port to maintain U.S. competitiveness with other coal-exporting countries appears realistic. 2/ The Office of Technology Assessment has estimated that about 10 percent can be cut from the cost of export coal as received by Europe and the Pacific Rim countries if U.S. ports could handle these super-colliers. 3/ At current and projected levels of export-coal demand, it appears to be cost

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1. See U.S. Army Corps of Engineers, National Waterways Study, Institute for Water Resources, review draft (July 1981).

2. Most coal-exporting and -importing countries have at least one deep draft port equipped to service super-colliers. The only U.S. port deeper than 45 feet, however, is Long Beach, California, and it is not equipped to service a large volume of coal.

3. See Office of Technology Assessment, Coal Exports and Port Development (April 1981).

effective to dredge one or two ports to 55 feet, so that lower coal prices could be realized without overinvesting in port deepening. The average cost of deepening a major coal port is about $600 million.

### Dams

The Corps of Engineers recently conducted a nationwide inspection of about 9,000 primarily nonfederal dams (roughly one-seventh of the United State's some 68,000 dams) and found that about one-third, or nearly 3,000 dams, were unsafe because of inadequate spillway capacity, unstable structural components, seepage, or inoperable components. 4/ Most of these unsafe dams were privately owned (64.8 percent) or state-owned (34.8 percent), with a very small percentage (0.4) owned by the federal government. Nearly 3,000 federally owned dams were not inspected, however, and many of these could be unsafe as well. Rehabilitating all unsafe nonfederal dams (based on one-third of the total nonfederal dam inventory) could cost an estimated $6.8 billion over ten years.

## CURRENT POLICY IN WATER RESOURCES

The federal government has assumed responsibility for certain types of water resource projects primarily to stimulate regional economic development, and for others, to provide nonsalable benefits that the private market would not furnish. Federal water resources programs for financing, constructing, and operating water resources projects are administered primarily by four agencies: the Corps of Engineers, the Department of the Interior's Bureau of Reclamation, the Department of Agriculture's Soil Conservation Service, and the Tennessee Valley Authority (TVA). In all, about 25 federal agencies have some authority for water resources development. The Corps of Engineers has built and maintained inland waterways and ports under various rivers and harbors acts since 1826. All four federal water agencies finance, build, and sometimes operate dams for a wide variety of purposes under an equally wide array of enabling federal statutes. Some 20 federal acts, dating back over a century, have formed the federal water resources program for these four agencies, including development for flood control, drainage, irrigation, municipal and industrial water supply, fish and wildlife conservation, navigation, hydroelectric power, and area redevelopment.

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4. See U.S. Army Corps of Engineers, National Program of Inspection of Non-Federal Dams, Final Report to Congress (May 1982). Of all the unsafe dams, about 82 percent were so judged because of inadequate spillways, which can undermine dams' structural soundness.

## Cost Sharing Conventions

For most types of projects, the federal government finances all capital costs but ultimately pays for somewhat less because of reimbursements from users and other nonfederal contributions. Cost sharing for joint federal/state water resources projects varies according to the type of project and lead federal agency. For the average inland waterway or harbor project, the federal government pays about 93 percent of combined capital and operating costs over the project's life. The average federal share of a multipurpose dam project is about 70 percent of combined costs, but portions may vary from a low of about 36 percent for a single-purpose hydroelectric project to a high of about 89 percent of an irrigation project (see Table V-1). 5/ States or localities generally contribute land, easements, or rights-of-way; users sometimes repay part of the initial capital cost and more often, pay operating and maintenance costs. Together, state and user contributions cover the nonfederal share.

## Federal Spending

In the early 1960s, annual federal spending for construction, operation, and maintenance of water resources projects averaged between $5.5 billion and $6.5 billion. Since reaching a peak in 1965, federal spending has generally declined, standing now at a low point of $3.7 billion (see Figure V-1). Since the late 1970s, federal capital expenditures have declined even more rapidly. The Corps of Engineers' combined capital outlays for flood control, multipurpose dams, and navigation, for example, fell from about $2.1 billion to $1.2 billion between 1977 and 1983. The primary reason for such a steep decrease, besides budgetary pressures, has been the inability of the Congress and the Executive Branch to reach an accord over the proper role of the federal government in making water resources investments. As a result, no federal water resources projects have been authorized since 1976. 6/ Overall, however, water resources expenditures appear to be shifting, away from massive new construction projects and toward rehabilitation of existing public works and more efficient management.

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5. See Water Resources Council, Options for Cost Sharing--Part 5A, Planning and Cost Sharing Policy Options for Water and Related Land Programs, (November 1975).

6. For further treatment of this subject, see forthcoming CBO study of options for water resources development policy.

TABLE V-1. EFFECTIVE NONFEDERAL COST SHARES OF FEDERAL WATER RESOURCES DEVELOPMENT, BY AGENCY
(In percents)

| Services | Army Corps of Engineers | Bureau of Reclamation | Soil Conservation Service | 25 Federal Agencies |
|---|---|---|---|---|
| | | MULTIPURPOSE DAMS | | |
| Urban Flood Damage Reduction | 17 | a/ | a/ | 20 |
| Rural Flood Damage Reduction | 7 | 10 | 27 | 11 |
| Irrigation | 19 | 18 | 54 | 19 |
| Municipal and Industrial Supply | 54 | 71 | 100 | 64 |
| Hydroelectric Power | 61 | 65 | b/ | 64 |
| Water Quality | 3 | 82 | b/ | 60 |
| Fish and Wildlife | 11 | 13 | 57 | 14 |
| General Recreation | 17 | 18 | 63 | 19 |
| | | NAVIGATION WORKS | | |
| Inland Waterways c/ | 6 | 7 | b/ | 6 |
| Commercial Harbors | 16 | b/ | b/ | 16 |
| All Navigation | 7 | 7 | b/ | 7 |
| Agency Mean | 20 | 37 | 49 | 30 |

SOURCE: Congressional Budget Office from Water Resources Council data. (TVA data not included.)

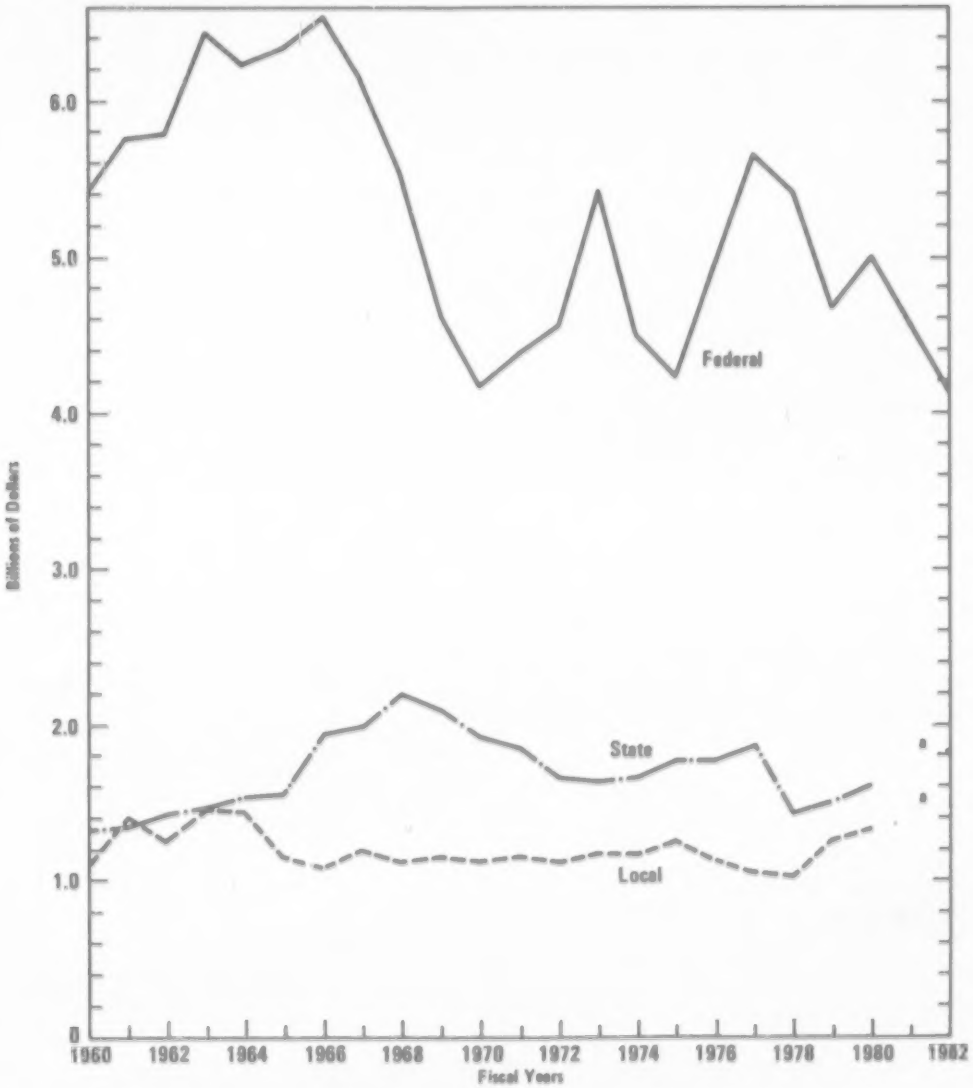
a. Agency reported a cost category for this purpose but not cost sharing.

b. Agency indicates no activity for this purpose.

c. Receipts from the fuel tax implemented pursuant to the Inland Waterway Revenue Act of 1978 are not included; estimates may therefore be slightly low.

Figure V-1.

## Federal, State, and Local Spending for Water Resources, 1960-1982




SOURCE: Congressional Budget Office from data supplied by the Congressional Research Service and the U.S. Department of Commerce, Bureau of the Census.

[a] Actual state and local data for 1980-1982 not available.

## State and Local Spending

Over this same 1960-1980 period, state spending for water resources has fluctuated only narrowly, between $1.2 billion and $2.0 billion a year. Local spending has also been relatively stable, fluctuating between an annual high of about $1.4 billion in 1963 and a low of about $1.0 billion 1978. In 1981, funding from four sources was commonly used by the states to meet their own water resources needs and to provide the nonfederal capital share of some federal projects: appropriated funds from general state revenues ($184 million), general obligation bond issues ($1.1 billion), revenue bonds ($840 million), and dedicated taxes or user fees ($138 million). 7/ Figure V-2 displays how funding from these four sources combined to provide about $2.3 billion for state use in water resources in the last two years.

## Economic Effects of Water Projects

Despite extensive research, general conclusions regarding the macroeconomic effects of water projects remain obscure. One recent survey of some 80 published studies suggests three observations: 8/

- Major water resources projects do not appear to be a critical factor in national economic development; rather, they tend to shift economic growth from one region to another.

- Water projects are not the most efficient investments to stimulate jobs or countercyclical economic development; direct tax incentives or public service employment are more cost effective in achieving these goals.

- Very little is known about the economic effects of infrastructure rehabilitation investments; much more is known about the effects of new construction.

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7. These data were collected from state water resources and budget personnel for 1981 and 1982. Fiscal year conventions, budgeting practices, and accounting systems vary widely among the states, making any estimate of this nature very imprecise. These estimates should be considered a "snapshot" in time, subject to change for a different period of analysis.

8. See Northeast Water Resources Project, The Economic Impact of Water Resources, a report prepared by the Nova Institute for the Consortium of Northeast Organizations (September 1979).



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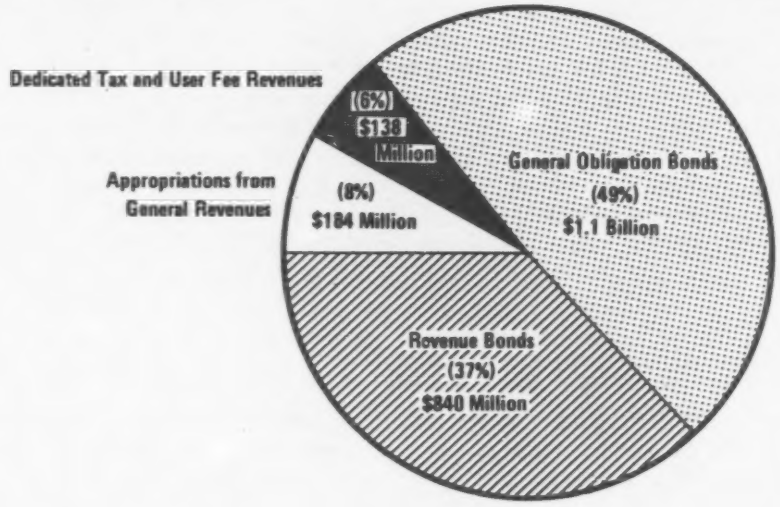
Figure V-2.

State Funding for Water Resources Projects by Source, 1981-1982




SOURCE: Congressional Budget Office.

## Major Financial Needs

On the basis of the assessments above of current condition of the three types of water resources facilities, about $1.2 billion a year in new capital expenditures could be needed between 1983 and 1990 to improve inland navigation works, deepen three harbors, and improve the safety of nonfederal dams (see Table V-2). About $48 billion in authorized Corps of Engineers or Bureau of Reclamation water projects are currently awaiting funding from the Congress. Many of these projects have local support only because of the generous federal cost-sharing terms offered at the time they were authorized; some local monies were committed solely to leverage the much larger federal sums. Further, many of these projects do not represent a need in terms of safety or public health or well-being. Finally, some projects counted in the $48 billion backlog may also be represented in the estimate of needs for inland waterways and ports; hence, they may be counted twice. Conservatively, if 25 percent of this backlog represented genuine federal needs, an additional $0.6 billion a year would be included in a needs estimate. Finally, about $2.3 billion would be spent each year until 1990 to complete all ongoing federal water resources construction and major rehabilitation projects. Needs could total about $4.1 billion a year, of which the federal share would be about $3.7 billion.



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TABLE V-2. CAPITAL NEEDS ESTIMATE FOR WATER RESOURCES, 1983-1990 (In billions of dollars)

| Type of Water Resource and Timespan of Estimate | Estimate of Total Needs | Annual Needs | |
|---|---|---|---|
| | | High Estimate | Low Estimate a/ |
| Inland Waterways (31 years) | 12.3 | 0.4 b/ | 0.3 |
| Ports and Harbors (31 years) | 1.7 | 0.06 b/ | 0.02 |
| Dam Safety (Ten years) | 6.8 c/ | 0.7 d/ | 0.4 |
| Backlog of Authorized Projects (20 years) | 12.0 | 0.6 e/ | 0.3 |
| Ongoing Construction Projects (Seven years) | 16.1 | 2.3 f/ | 2.3 |
| Total g/ | | 4.1 | 3.3 |

SOURCE: Congressional Budget Office and other sources cited below.

a. Reestimates by CBO.

b. Corps of Engineers estimate includes rehabilitation of 58 locks, four major channel deepenings, 206 safety actions, and miscellaneous rehabilitation. See U.S. Army Corps of Engineers, Institute for Water Resources, National Waterways Study (July 1981 review draft).

c. Calculated by CBO from available Corps of Engineers data on known costs, extrapolated for one-third of all nonfederal dams. (The corps cautions that this methodology can be misleading.)

d. Corps of Engineers estimate. See U.S. Army Corps of Engineers, National Program of Inspection of Non-Federal Dams, Final Report to Congress (May 1982).

e. Authorized backlog of Corps of Engineers and Bureau of Reclamation projects only. Data reestimated by CBO.

f. Based on construction outlays of the Corps of Engineers, Bureau of Reclamation, and Soil Conservation Service in 1982, held constant over the average construction period of seven years. Reestimated by CBO.

g. Details may not add to totals because of rounding.

## EFFICIENCY OF CURRENT PROGRAMS

Undercharges to users appear to have caused exaggerated estimates of needs for water resources investments. The federal government has a clear role in meeting many of the water resources needs, but state and local governments, and users as well, have a major stake in safe, efficiently operated water projects. Under current cost-sharing policies, what emerge as "needs" may well be inflated by an overly generous federal share. Because the nonfederal participants in water resources projects pay so small a portion of costs, they have an incentive to promote all projects, regardless of their real perception of "need" for the project. For example, local sponsors pay only 17 percent of the costs to construct flood control dams, 11 percent of the cost to construct irrigation dams, and 7 percent of the cost of navigational facilities. Yet, the benefits of these projects accrue mostly to these small groups of users. Many projects now classified as needs could probably be eliminated if users were faced with paying the full costs of water-related services provided them.

Though pinpointing such reductions is difficult, several recent studies help make rough estimates possible. On the basis of a 25-year economic forecast, Data Resources Incorporated (DRI) recently projected inland waterway traffic under full-cost user fees between 1980 and 2000. 9/ No congestion-related new construction, DRI concluded, would be needed anywhere on the inland waterway system under full cost user fees. This calls into question a Corps of Engineers' estimate of $3.0 billion of channel modification over 31 years. Though deepening coal ports would provide capacity expansion and real savings on the U.S. export price of coal, the 1980 surge in coal export demand has subsided, and forecasts since then are more conservative. Even without any deepening to service super-colliers, if estimated coal port capacity in 1990 is measured against estimated export demand by region, on average, east coast ports could have 55 percent "over-capacity," and gulf coast ports could have 59 percent over-capacity. 10/

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9. New lock capacity could be called for around the year 2000. See Data Resources, Inc., The Impacts of Waterway User Fees on Barge Traffic and Water-Served Regions, report prepared for the U.S. Department of Transportation (1982).

10. Over-capacity estimates consider current aggregate export capacity, reasonably firm plans for new capacity (berths, storage, transfer facilities), projection of demand from countries importing U.S. coal, and estimates of the U.S. share of the world coal market (35 percent of the European market and 25 percent of the Far East market in 1990). See Robert C. Major, U.S. Steam Coal Exports: Who Will Benefit? presented at Data Resources International Petroleum and Coal Conference, Pittsburgh, Pennsylvania (November 19, 1981).

Coupled with reduced export demand and excess port capacity, increased prices arising from user fees could reduce the Corps of Engineers' estimate of deep-draft needs by two thirds (that is, by deepening only one coal port instead of three).

Finally, considerable uncertainty surrounds the classification of backlogged water projects as needs. CBO's estimates--though they must be considered highly uncertain--suggest major shortcomings in economic efficiency in this area. If, as a condition of construction, users were asked to pay for the benefits they received, perhaps half of the backlogged projects would be dropped (see Table V-2). 11/

## FEDERAL STRATEGIES TO IMPROVE WATER RESOURCES INVESTMENT

Under current policy, the federal government pays for about 76 percent of the construction costs of water resources projects. If current policy is maintained, CBO estimates that the federal government will have to spend about $3.7 billion a year--an additional $1.4 billion each year--between now and 1990 to meet estimates of water resources capital needs. Nonfederal participants in water projects would have to expend an additional $400 million a year.

Financial accountability for water projects could instead be spread among all levels of government by increasing the nonfederal share of project costs and implementing user fees in certain instances. Such changes would result in higher prices for water resource services for direct beneficiaries and for nonfederal governments. In turn, water resources officials would be more likely to promote only the most efficient water projects--namely, those that would return benefits in excess of costs. Three alternatives to current policy--a federal loan program, a redirection of the federal role, and institution of block grants--could be effective in furthering this goal.

### Federal Loan Program

A federally established loan fund would permit the federal government to serve almost exclusively as a financing partner for new intrastate water projects. This assumes that user fees can correct chronic overestimates of

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11. For more information regarding the problems of backlogged water projects, see General Accounting Office, Water Project Construction Backlog--A Serious Problem With No Easy Solution (February 1983).

needs, and that the federal government has a competitive advantage over state or local governments in financing relatively expensive water projects. States, possibly with local assistance, could select and manage these projects, design and implement user fee systems to recover appropriate project costs, and agree to repay federal loans with the fees collected and with supplementary state payments. Under this option, all benefits produced by water projects could be classified as vendible (such as port improvements, hydropower, irrigation, municipal and industrial water supply, and recreation) or non-vendible (such as flood control, fish and wildlife conservation, and water quality). To repay federal loans, vendible benefits would be marketed by states at cost-of-service prices or higher. In addition, states could agree to repay half of the costs associated with providing non-vendible benefits. Assuming the low estimate of needs, under this option, the federal government could spend an additional $700 million a year through 1990, but out of each year's additional outlays, at least half would be repaid (with interest) over a 50-year period. If especially remunerative projects were undertaken, much more of the federal investment could be repaid.

Under this scheme, the federal government would continue as the principal financial backer and manager of interstate water projects, including the inland waterways and multipurpose reservoirs affecting entire river basins. Federal user fees would be implemented where appropriate, however. Between $300 million and $500 million would be spent each year for these federal purposes, most of which would be repaid by users.

A federal loan program could hold total federal outlays for constructing water resources projects to about $3.1 billion each year, or an increase of about 35 percent above current spending.

User Fees as a Guide to Needs--An Advantage. A federal loan program coupled with user fee increases would encourage a more realistic assessment of needs for several reasons. First, before an intrastate project was started, a joint federal and state feasibility study would be conducted. Potential users of vendible benefits would be presented with an estimate of the costs they would have to bear if the project were constructed. The state would also compare expected benefits with its share of residual costs. If either user groups or the state judged the project to be uneconomic, it would not go forward as planned. Either the project scope would be altered until benefits were perceived to be greater than costs, or the project would be eliminated, allowing the state and the federal government to commit their resources elsewhere.

Second, because states would be financially responsible for repaying a much larger share of any project's cost than they now pay, those projects

perceived by the state to offer the highest net return on the investment would be promoted first. Under this option, states would be responsible for repaying a minimum of half of any project's capital cost, even if all benefits were classified as non-vendible. This would be a significant increase over the current average nonfederal share of 24 percent.

Finally, users would pay at least the full cost of service for vendible benefits. This would result in significant increases in the prices paid for federally subsidized water and related benefits. Users, in turn, would conserve water where possible or make other efficiency adjustments motivated by the real, unsubsidized price of water (see also Chapter VIII).

Disadvantages. Under this scheme, high demand for federal loans could deplete the loan fund rapidly, especially in the early years of the program before state payments fully replenished the balance. If loan demand were high, distribution of available funds among the states could pose problems. Because the project itself would serve as collateral on the loan, defaults could prove burdensome and expensive for both the federal government and the defaulting states. One result could be conflicts over water rights if the federal government repossessed a project to recover its investment.

## Redirected Federal Role

A premise for reorienting the federal role is that future water resources needs will be mainly management or rehabilitation, not new construction, and that these activities are most efficiently financed and administered at the local level. Further, this "federalist" approach recognizes that most of the large multipurpose or interstate water projects have already been built, leaving smaller intrastate projects as the basis of needs estimates. Finally, the growing financing and financial management capabilities at the state and local levels would be taken into account, as these governments would be the centers of financial activity for water projects.

Under this approach, the federal government would only participate in water projects that have a clear federal function, and then only to a limited extent: financing projects with implications for national security (some ports and harbors), interstate commerce (inland waterways), or internatic nal effects (stream-flow maintenance projects); managing projects that physically affect more than one state, such as multi-state navigation or reservoir systems; or facilitating negotiation between states over projects that involve unavoidable multi-state cost or benefit spillovers. Federal funds used to build new or to operate existing interstate projects would be recouped with federally administered user fees to the degree that the

federal investment produced vendible benefits. All new intrastate projects would be financed, planned, constructed, and operated at the state or local level. Operation and maintenance of existing intrastate projects would be transferred to the states over a ten-year period.

Advantages. Federally administered user fees would match costs to beneficiaries, conditioning investments with users' willingness to pay and reducing the tendency for overinvestment. This federalist approach would also reduce the size of federal water agencies and the cost of federal water programs. Out of about $3.7 billion in federal water resources expenditures in 1982, about $1.5 billion, or 41 percent, would have been a state responsibility if this option were in effect.

Disadvantages. Under this option, states that are not in a strong fiscal position could be put at a relative disadvantage. Energy-exporting states or states with growing industrial and population bases (western and southern states) could probably expand their financial, technical, and management roles in water resources development much more readily than could states with shrinking populations and industrial bases (north central and northeastern states). In addition, shippers on the inland waterways and other users of federally supported interstate projects would pay more for these services than they now pay.

### Block Grants and Federal User Fees

Under a block grant scheme, a fixed level of non-reimbursable federal funding would be allocated to the states each year for intrastate water projects on the basis of criteria such as population, land area, and proportional "need" (as defined in Table V-2). Block grant monies could be used for any water development or maintenance purpose, as long as minimum matching requirements were met. 12/ The states would maintain priority lists of intrastate projects and feasibility studies and would make funding decisions based accordingly. A project could only be listed as a state priority if it passed federal and state engineering, environmental, and economic feasibility standards. The federal government would finance interstate water projects such as waterway dredging or lock and dam replacement on a project-by-project basis. Federally administered user fees

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12. A proposal along these lines, introduced in 1981 as S. 621 by Senators Domenici and Moynihan, would have instituted a minimum 25 percent state match for construction and 50 percent for operation and maintenance. If the existing cost-sharing rate for any type of project were higher, it would replace the minimum match.

would recover up to 100 percent of the federal investment in interstate water resources projects.

Promoting Economic Efficiency--An Advantage. Assuming that interstate project construction was conditioned on users' willingness to pay appropriate fees, economically efficient federal investments would follow. For intrastate projects, however, user fees would not be mandatory, and states could subsidize groups of users if they so desired. There would be no guarantee that federal funds allocated to states would be used to build the most efficient projects in terms of number, size, or location. Almost certainly, though, intrastate projects would be built faster than under current policy.

Disadvantages. Matching grants imply a financing role for the states. If matching rates were high, the financing burden on the states would also be high. Some states are building their own water projects now, and this new funding mechanism could substitute for local capital, effectively creating a subsidy. Other states, however, rely on federal financing to build water -r jects. To the degree that projects were cancelled for lack of state matching funds, more prosperous states would get federally subsidized intrastate water projects while less prosperous states would not.

Regional Effects. If the federal government financed interstate projects, and if block grants (for intrastate projects) were distributed on the basis of needs, Ohio and Mississippi River Valley states would receive most of the inland waterway needs funding; Missouri, Texas, Pennsylvania, and Georgia together would receive about 37 percent of the dams needs. Funding for authorized but backlogged projects would be distributed to the South (40 percent), West (36 percent), North Central region (18 percent), and Northeast (6 percent). 13/

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13. Based on historical distribution of water resources funding. For additional details, see Congressional Research Service, Water Resources Expenditures, series of tables depicting regional and state distribution of federal water resources expenditures, developed at the request of the staff of the Senate Committee on Environment and Public Works, 1982.

## CHAPTER VI. AIR TRAFFIC CONTROL

*Though still adequate to assure safety, the air traffic control system, run by the Federal Aviation Administration, is in need of modernization. The Congress has approved the FAA's National Airspace System Plan, which according to the FAA could cost an estimated $10.7 billion to implement but could save $25 billion by the year 2000 by replacing antiquated equipment with modern microchip technology. CBO analysis points to a conclusion that investment in this plan would prove sound no matter what course growth in aviation takes in coming years. Implementation of the plan, however, would depend critically on consolidation and closure of many facilities, which would entail major personnel reductions and would likely encounter strong opposition. The pace of modernization could be altered to allow gradual and more cost-effective phase-in of new technologies. A slowing of the growth in air traffic, which could result from withdrawing subsidies and raising user fees on general aviation (small aircraft used for corporate business and recreation) to levels that recovered the full federal costs of services to that class of users, could buy time to allow the FAA plan to be implemented in stages that would institute new equipment as it develops.*

### THE PROBLEMS IN AIR TRAFFIC CONTROL

Flight in the nation's airspace is controlled and monitored by a system of 25 en route navigational centers, 188 terminal area approach stations, and 442 airport terminal control towers--the air traffic control system. In addition, 317 flight service stations provide general aviation pilots with aviation maps, weather reports, and other flight services. To equip, maintain, and staff this system, the Department of Transportation's Federal Aviation Administration (FAA) spent more than $2.5 billion in 1982, of which about 11 percent paid for capital improvements, and nearly 90 percent was devoted to air traffic controllers' salaries and other operating costs (see Table VI-1). Although only about 75 percent of the FAA's operating expenses are financed by fees collected from aircraft operators

TABLE VI-1. FEDERAL CAPITAL AND OPERATING EXPENDITURES FOR AIR TRAFFIC CONTROL UNDER CURRENT POLICY (In billions of dollars)

| | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|---|
| Capital Investment a/ | 0.29 | 0.31 | 0.49 | 0.84 | 1.08 | 1.11 |
| Operations | 2.29 | 2.46 | 2.31 | 2.18 | 2.06 | 1.96 |
| Total | 2.58 | 2.77 | 2.80 | 3.02 | 3.14 | 3.07 |

SOURCE: Outlays projected by Congressional Budget Office from budget authority given in Airport and Airway Improvement Act of 1982.

a. Annual budget authority for capital 1983-1987 was $0.73 billion, $1.39 billion, $1.41 billion, $1.38 billion, and $1.16 billion.

and passengers, all capital investment--the primary focus of this chapter--is financed in this way.

Today's air traffic control system has evolved over 40 years, producing a mixture of equipment and technologies of many ages and types. The system has been adequate to assure the safety of air travel, but technological limitations already delay air travelers and incur very high operating and maintenance costs for the FAA. The air traffic control equipment now in use--relying heavily on vacuum tubes--is highly labor intensive and is becoming increasingly costly to buy, maintain, and repair. Further, it is slow to process data received by radar stations and cannot handle the large volume of aircraft use projected to develop in coming years (see also Chapter VII). The far cheaper and more efficient microchip technology that has developed over the last decade makes the current generation of equipment obsolete.

Since technological opportunities now permit greater automation, the air traffic control system could be operating with much greater efficiency than it now does. For example, controllers now determine correct aircraft separation on the basis of radar data, and most data, after being processed by computers, are coded on paper strips torn by hand from computer

printers. This is a costly mechanical system requiring coordination and input by the air traffic controllers. The handover by telephone of aircraft en route from one controller to another is also primitive by today's standards. Automating these functions would sharply reduce requirements for facilities and manpower while simultaneously curbing the reliability problems common in labor-intensive mechanical operations.

Compounding the problems of inefficient and obsolete equipment, anticipated traffic growth--projected by the FAA to increase by 50 percent over the coming decade--promises to place demands on the system that it could not meet safely with present capacity. Although the FAA projections have been criticized as too high, 1/ they appear accurate with regard to the mix of demand from users. Commercial air carriers are expected to account for 22 percent of projected demand growth, while much more--60 percent--is anticipated to arise from general aviation (that is, operators of small private aircraft for business and recreational purposes).

Demand on traffic control towers and en route centers depends largely on the number of aircraft that are active, rather than on the types or uses of aircraft served. Even though air carrier passenger miles could increase by as much as 80 percent by 1994, the number of actual air carrier aircraft is expected to rise by only one-fourth, reflecting the growing use of large aircraft with greater seating capacity. The number of planes in the general aviation fleet, on the other hand, could grow by up to 50 percent, with numbers of business jets--the most active general aviation users of air traffic control--more than doubling. In addition, greater use of avionics (radar transponders that enable pilots to communicate with approach stations, control towers, or en route centers) by existing general aviation planes would exert pressure on the system to expand.

## The Costs of Neglect

Without sufficient investment to modernize the air traffic control system, significant costs could arise in the form of diminished safety, higher system running costs, and insufficient capacity. To maintain safe separations between aircraft in flight, traffic controllers using inadequate instruments already require air carrier planes to use roundabout routings that waste fuel and time and consume the useful life of aircraft. Thus, failure to improve the system would result in significant costs for air carriers as well as general aviation. By the late 1980s, air carriers would need to reduce the

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1. See Office of Technology Assessment, Review of the FAA 1982 National Airspace System Plan (August 1982).

number of scheduled flights to accommodate the system's limited capacity. Inefficient routings would add an estimated 90 million hours to passengers' flight times; airlines would waste an estimated one billion gallons of jet fuel. And the FAA's operating costs would be some 50 percent higher than they are today. 2/

## CURRENT POLICY IN AIR TRAFFIC CONTROL

Federal coordination and control of air traffic activities minimizes overall administrative costs and ensures uniform rules of navigation and air safety. Although a few local airport authorities install their own navigational instruments, the number of such initiatives has accounted for a very minor share of total air traffic control investment since 1960.

Cumulative capital investment since 1960 in the nation's air traffic control system totals $8.5 billion, all of which has been federally funded. Federal spending over the years displays an erratic pattern, reflecting shifts between periods of high-cost system expansion and periods of low-cost routine repair and replacement (see Figure VI-1). The 1950-1960 decade was one of expansion, as the system grew to accommodate the post-War boom in commercial aviation; the number of airports equipped with control towers rose by more than 50 percent, and five en route centers were added (see below). System capacity stabilized between 1960 and 1967, but a grow-

| | 1960 | 1973 | 1982 |
|---|---|---|---|
| Number of Airport Towers | 256 | 365 | 444 |
| Percent change in ten years | +53 | +43 | +22 |
| Number of En Route Traffic Control Centers | 35 | 27 | 25 |
| Percent change in ten years | +17 | -23 | -7 |

ing number of reroutings, lengthy holding patterns, and forced airline schedule reductions necessitated another round of system expansion and automation from 1967 to 1972. By 1973, an additional 109 airports were equipped with control towers, and automation at en route control cen-

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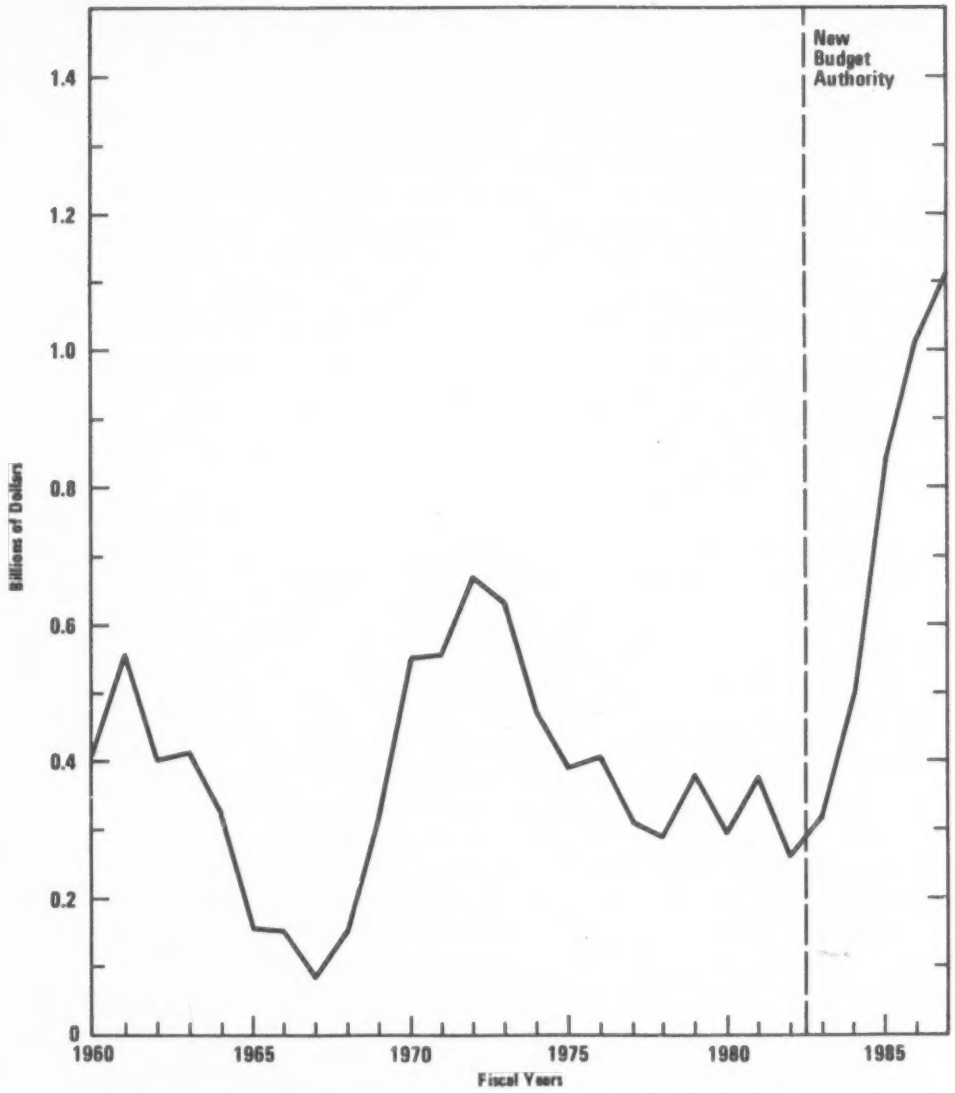
2. From Federal Aviation Administration, Aviation Forecasts (February 1983), and U. S. Department of Transportation, National Airspace System Plan (December 1981, updated April 1983).

Figure VI-1.

## Actual and Projected Federal Capital Spending on Air Traffic Control, 1960-1987




SOURCE: Congressional Budget Office from data provided by the Federal Aviation Administration.

NOTE: Outlay figures for 1983-1987 are based on authorizations in the Airport and Airways Improvement Act of 1982.

ters--by means of digital computers and more advanced software, and better displays--increased the hourly number of flights handled by 30 percent, while permitting an actual reduction in the number of centers to 27.

The last ten years have witnessed a return to declining investment in the air traffic control system. In managing the system, the FAA has concentrated capital funds on system maintenance, relying on the addition of more air traffic control personnel to handle growing demands for service. Since the Professional Air Traffic Control union (PATCO) walkout in 1981, the system has been kept operating with a reduced work force by the FAA's administratively limiting air traffic. As of February 1983, there were 23,257 air traffic controllers employed--10.9 percent fewer than the 26,088 authorized, owing to the lingering effects of the strike.

## Major Air Traffic Control Investment Needs Under Current Policy

The National Airspace System Plan published by the FAA in December 1981 and approved by the Congress in 1982 under the Airport and Airway Improvement Act charts a future course for the air traffic control system. 3/ With annual authorizations of roughly $1 billion, the FAA plan would automate and consolidate components of the air traffic control system. Through automation, it would increase traffic handling capacity, diminish the risk of mid-air collision and other hazards, and shorten flight times by allowing aircraft to use more direct routes. By consolidating facilities and reducing staff, the plan would lower FAA operating and maintenance costs. By the year 2000, the present 25 en route navigation centers and 188 airport approach facilities would be merged into about 30 facilities, and the 317 flight service stations would be reduced to 61. Staffing would be cut accordingly, from its authorized level of 37,122 in 1983 to 30,200 in 1985, and to 24,200 by the turn of the century.

On the basis of FAA estimates, the major cost of modernization--not only to the federal government but to private-sector users as well--will total $10.7 billion in 1982 dollars by the turn of the century (see Table VI-2). Most of this cost--about 72 percent--represents direct federal investment in computer hardware and software and in other improved equipment. The remainder represents investment expense for the airline industry and general aviation users, who would have to purchase compatible cockpit equipment (transponders and other avionics equipment). Federal funding for the first five years of the program was authorized in 1982 at $1 billion a

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3. See U. S. Department of Transportation, National Airspace System Plan (December 1981, updated April 1983).

year under the Airport and Airway Development Act. Although the National Airspace System Plan would capture a number of technological opportunities to improve the efficiency of the existing system, it may--from a technological standpoint--be premature in the rate at which it would expand existing capacity.

## EFFICIENCY OF CURRENT POLICY--THE FAA PLAN

As with any long-range investment, the estimated benefits and costs of modernization under the FAA's National Airspace System Plan hinge on a number of policy assumptions and other forecasts. Some of the major assumptions that underlie the FAA plan include continued heavy federal subsidization of general aviation users (see also Chapter VII), an ability to consolidate facilities and thus achieve significant savings in operating costs, and no cost overruns.

On the basis of these assumptions, the FAA has projected that, by the year 2000, the plan would save the federal government $25 billion in operating and maintenance costs--about two-thirds of the total benefits it expects from the plan (see Table VI-3). The remaining one-third of the benefits would accrue to the airlines and general aviation users in the form of lower running costs and shortened delays. (The FAA made no attempt to place a dollar value on most of the expected safety improvements.)

On the basis of these projected costs and benefits (compare Tables VI-2 and -3), the CBO calculates that the annual rate of return to be expected from the plan over the next two decades is 24.3 percent--a healthy return by any standards (see Table VI-4). Indeed, compared with the commonly used (though somewhat arbitrary) standard of 10 percent set by the Office of Management and Budget (OMB) for federal investment, the FAA plan appears to represent very good value. Another useful guide to the economic merit of a capital project is the present value of the expected benefits, minus the costs. Using FAA assumptions, and 10 percent as the discount rate to adjust future costs and benefits to their present-day values, the benefits of the FAA plan are estimated to exceed the costs by $9.1 billion for a benefit-to-cost ratio of 2.3:1.

When should modernization begin? One index of whether a project is well timed is how long the nation must wait before the investment begins to pay off. A long waiting period means that success of the plan hinges on ever more distant forecasts, and such distant forecasts inevitably tend toward speculation. On the basis of the FAA estimates of costs and benefits, the plan would begin to pay for itself (that is, achieve a 10 percent or greater rate of return) within the next five years. This would suggest minimum risk in going ahead with the project now.



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TABLE VI-2. PROSPECTIVE COSTS OF IMPLEMENTING THE NATIONAL AIRSPACE SYSTEM PLAN, 1983-2005

| Sources of Costs | Total Cost 1983-2005 | | Present Value with 10 Percent Discount Rate a/ | |
|---|---|---|---|---|
| | In billions of dollars | As percent of total | In billions of dollars | As percent of total |
| Federal Investments | 7.65 | 71.7 | 5.73 | 82.7 |
| Avionics Costs to Users | | | | |
| Transponders and other equipment b/ | 2.42 | 22.7 | 0.88 | 12.7 |
| Microwave Landing System | 0.59 | 5.6 | 0.32 | 4.6 |
| Total | 10.66 | 100.0 | 6.93 | 100.0 |

SOURCE: Congressional Budget Office from data provided by Federal Aviation Administration.

a. 10 percent represents the minimum rate of return set by the Office of Management and Budget for federal capital investments.

b. Includes Traffic Alert and Collision Avoidance System (TCAS).

## Effects of Possible of Errors in the FAA Assumptions

The foregoing conclusions are, of course, only as valid as the assumptions and forecasts on which they are based, and these cannot be absolutely certain. Thus, it is necessary to look at what could happen to the plan if things do not go as assumed.

TABLE VI-3. PROSPECTIVE BENEFITS FROM THE NATIONAL AIRSPACE SYSTEM PLAN, 1983-2005

| Benefits | Total Benefits, 1983-2005 | | Present Value with 10 Percent Discount Rate [a] | |
|---|---|---|---|---|
| | In billions of dollars | As percent of total | In billions of dollars | As percent of total |
| Savings in FAA Operating Costs from Increased Productivity | 37.09 [b] | 62.2 | 10.64 | 66.5 |
| Savings in Fuel from Transponders and Other Equipment [c] | | | | |
| Air carriers | 11.29 | 18.9 | 2.62 | 16.4 |
| General aviation | 5.07 | 8.5 | 1.13 | 7.0 |
| Savings from Microwave Landing System | | | | |
| Improved safety | 0.28 | 0.5 | 0.08 | 0.5 |
| Reduced disruptions | 2.52 | 4.2 | 0.66 | 4.1 |
| Reduced outages | 0.24 | 0.4 | 0.07 | 0.4 |
| Reduced ground and air restrictions | 1.99 | 3.3 | 0.50 | 3.1 |
| Shortened approach path length | 1.12 | 1.9 | 0.30 | 1.9 |
| Total [d] | 59.60 | 100.0 | 15.99 | 100.0 |

SOURCE: Congressional Budget Office from data provided Federal Aviation Administration.

a. 10 percent represents the minimum rate of return set by the Office of Management and Budget for federal capital investments.

b. The FAA estimates that savings in operating costs would total $25 billion by the year 2000. The CBO has projected another five years of savings for analytic purposes. However, the discounting of future costs makes this difference of very little significance.

c. Traffic Alert and Collision Avoidance System (TCAS).

d. Details may not add to totals because of rounding.

TABLE VI-4. ECONOMIC EVALUATION OF THE NATIONAL AIRSPACE SYSTEM PLAN UNDER ALTERNATIVE ASSUMPTIONS

| CBO Assumptions | Annual Rate of Return (In percents) | Discounted Benefits Minus Discounted Costs (In billions of dollars) a/ | Ratio of Benefits to Costs a/ |
|---|---|---|---|
| Operating Cost Savings Delayed Five Years | 13.9 | 3.1 | 1.5 |
| Operating Cost Savings of Half those Assumed by FAA b/ | 9.1 | -0.4 | 0.9 |
| Cost Overrun of 25 Percent | 17.1 | 5.0 | 1.6 |
| FAA Assumptions | 24.3 | 9.1 | 2.3 |

SOURCE: Congressional Budget Office and Federal Aviation Administration data.

a. All benefits and costs are discounted to their 1982 values at the rate of 10 percent a year. The analysis period is 1982 to 2005.

b. Includes only federal investment costs and federal benefits in the form of savings in FAA operating costs. Excludes avionics costs to airlines and general aviation users, as well as direct benefits to them.

Subsidization of General Aviation Users. Modernization can yield sizable gains in efficiency independent of traffic growth. But if the FAA's traffic forecasts should prove too high, overall cost savings and incidental benefits would be lower than anticipated. The FAA's projections of future traffic growth assume that the federal government will continue its current

practice of subsidizing general aviation users in their access to air traffic control services. After applying its user fee payments to airport development, general aviation makes very little contribution to its 30 percent share of total traffic control system capital and operating costs. As a measure of the magnitude of this subsidy, recovery of all the costs that general aviation imposes would require the taxes paid by private plane owners to increase from the current 12 cents a gallon of gasoline and jet fuel to about $1.20 per gallon (or an equivalent amount raised through other taxes on general aviation). 4/ This subsidy to general aviation stimulates use of the system, and thus any substantial reduction in this subsidy would diminish the load on the air traffic control system.

Although the FAA plan would remain cost effective even with reduced general aviation traffic (because system modernization and consolidation would yield enough savings in FAA operating costs to justify the investment even if there were no growth in traffic), 5/ a diminished workload could allow the use of even more efficient approaches to system modernization. For example, en route centers now use computers built in the 1960s, and though these are still in good working order, they are not expected to remain adequate for processing the computer programs needed to handle the projected high volumes of hourly traffic in the mid- to late-1980s. The FAA's first step in implementing the plan is replacement of those computers. Use of existing software in new computers, however, runs the risk of freezing future system development, necessitating yet another round of investment in costly computer equipment a few years hence. This could be avoided if general aviation traffic grows more slowly than the FAA now assumes; with reduced subsidies and slower projected growth in air traffic, alternative approaches would be possible. These include delaying computer replacement and beginning immediately to design a complete system of hardware, software, and displays. These steps could take better advantage of advances in computer technology and provide a replacement system within the same time frame, according to the Office of Technology Assessment, and cost savings could amount to some $186 million. 6/

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4. This level of taxation would fully recover all the FAA expenses incurred on behalf of general aviation users, including airport investment.

5. See Statement of Alice M. Rivlin, Director, Congressional Budget Office, Before the Subcommittee on Transportation, Committee on Appropriations, U. S. House of Representatives, April 6, 1983.

6. See Office of Technology Assessment, Review of the National Airspace System Plan (August 1982).

Savings in Operating and Maintenance Costs. The FAA's projected savings of $25 billion over 20 years depend critically on the closure of hundreds of manned facilities and a reduction of 40 percent of the FAA's authorized work force level, or 14,800 personnel. 7/ In the past, such changes have encountered opposition in the Congress and among labor and aviation groups. Even if the same resistance delayed the changes this time by as much as five years, the project overall would still be worthwhile--with a rate of return of 13.9 percent. The project would take longer to pay off, though, and the Congress would be relying on more distant--and thus more speculative--forecasts to achieve an acceptable return on its investment.

If reluctance to make organizational changes obviated half of all projected savings in operating costs, then the FAA plan would no longer be economically worthwhile. In such a case, the discounted federal investment costs would exceed the discounted savings in FAA operating and maintenance costs (see Table VI-4).

Cost Overruns. Although CBO has not made a detailed assessment of the FAA's cost estimates, overruns are common in both public and private investments. Higher costs would diminish the value of the FAA plan, but such overruns would have to be quite large to bring about the plan's economic failure. For example, even with a 25 percent cost overrun and with less traffic than the FAA has forecast, the plan would still yield net benefits of $5 billion. In fact, capital costs would have to double before the costs would exceed the benefits, even with lower traffic forecasts.

## FEDERAL STRATEGIES TO IMPROVE AIR TRAFFIC CONTROL INVESTMENT

In August 1982, the Congress adopted the FAA's National Airspace System Plan with little modification. Annual program authorizations were increased from $260.8 million in 1982 to an average of $1.0 billion for the 1983-1987 period--enough to cover all modernization and expansion costs of the first phase of the plan (see Table VI-2). The FAA intends revenues from current user fees to recover these costs fully, although commercial air carriers would continue to subsidize general aviation users (see also Chapter VII). After allowing for their contribution to airport development, general aviation users would continue to cover hardly any of their allocable share. Thus, the Congress may wish to consider, in tandem with the FAA plan, a policy that would institute full-cost-recovery fees from general aviation users. This course might permit a more deliberate program for

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7. The reductions would affect not only 10,700 controllers but 4,100 maintenance and administrative workers as well.

system modernization. The merits of both the present FAA plan and a modification involving user fees should be considered from various viewpoints.

Safety and Efficiency. The FAA has recently published a preliminary analysis of the benefits it expects to result from the plan. 8/ Casualties are projected to be reduced, though by an undetermined amount. More direct routing would save one billion gallons of fuel each year. And FAA operating costs, as stated above, would be reduced by $25 billion over the next 20 years.

Service Consolidations and Personnel Cuts. The plan's economic success (benefits in excess of costs) hinges on its actually achieving the savings in FAA operating costs. These savings from automation depend on the FAA's ability to close and consolidate facilities and reduce its work force. To date, evidence of Congressional and other resistance to consolidating control facilities has included opposition to regional office cutbacks. The FAA's 1981 proposal to close five of its 11 regional offices stirred employee protest, state resistance, and Congressional opposition. As a result, the FAA modified its consolidation plan, reducing the number of proposed closings from five to two. In addition, statutory restrictions of flight service station closings could inhibit implementation of the plan. Current law stipulates that only five flight service stations may be closed in 1983, but the plan calls for closing 60 stations in 1984.

The Congress could take either a passive or an active role in smoothing the process. First, it could decide not to interfere with FAA plans to close facilities, or second, it could actually incorporate the FAA's schedule for consolidation and staff reductions as part of the appropriations process. This latter course might include setting lower appropriations that would, in effect, force the FAA to consolidate facilities and reduce staff.

## Increased User Fees

If fees, in the form of taxes on fuel, were levied on general aviation users and set to recover the full federal costs of those users' share of air traffic control, the effect would be to reduce general aviation demand for air traffic control to an economically justifiable level, and currently planned outlays for system expansion could be reduced by about 10 percent, to an

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8. See Federal Aviation Administration, Preliminary Analysis of the Benefits and Costs to Implement the National Airspace System Plan (June 1982).

average of $0.7 billion annually (see Table VI-5). Savings would come from delayed computer replacement, more advanced computer technology, more selective application of technologies, and from lower replacement costs made possible by reduced traffic levels. A fuel tax, set at a system-sustaining level, would not result in the most efficient level of demand, however, since it is not sensitive to the actual amount of use that each aircraft makes of the air traffic control system. For example, many recreational aircraft, which usually fly at low altitudes, require very little, if any, air traffic control service. Direct taxing methods, fees geared to the use of air traffic control service by each user, have been impractical in the past, although the FAA plan would introduce a new radar system capable of identifying each aircraft that uses the system, continuously monitoring each plane from take-off to landing. Data from the system could provide a detailed record of the services used and users could be billed accordingly.

TABLE VI-5. PROJECTED FEDERAL CAPITAL EXPENDITURES FOR AIR TRAFFIC CONTROL WITH FAA PLAN ALONE AND SUPPLEMENTED WITH USER FEES (In billions of dollars)

| | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| FAA Plan | 0.31 | 0.49 | 0.84 | 1.08 | 1.11 |
| With Increased User Fees | 0.26 | 0.42 | 0.77 | 1.01 | 1.02 |

SOURCE: Congressional Budget Office.

Adequacy of Air Traffic Control. Compared to the FAA plan as it now stands, a slower pace of automation with increased user fees could delay productivity improvements somewhat, although by how much cannot be determined precisely. The level of service could be roughly equivalent to that projected under the FAA plan, however, since fewer aircraft would be using the system. Thus, benefits from the plan supplemented with user fees--benefits in the form of fewer accidents, time saved, and fuel saved--could be about the same as benefits produced by the plan under current policies. On the other hand, if general aviation traffic grew more rapidly than is expected with higher fees, the more limited capacity could require administrative quotas to limit traffic (as were imposed during the PATCO strike), at least until additional capacity became available.

The tenfold increase in general aviation user fees that would have to be imposed to recover fully air traffic control costs occasioned by general aviation would cause a measurable reduction in the amount of general aviation activity (see Chapter VII). This in turn would help diminish airport congestion, delay, and capital requirements. If user fees were recovered through fuel taxes on general aviation, the specific effects of the increase would depend on the relationship of fuel prices to overall flying costs, and on the sensitivity of users to fuel price increases. At present, fuel accounts for about 20 percent of annual general aviation's flying costs. Thus, though a $1.20 per gallon fuel tax would increase fuel costs by some 85 percent, total flying costs would rise by only about 17 percent. The relatively small contribution that fuel makes to overall flying costs is reflected in the response of general aviation to past fuel price increases. Changes in general aviation activity as a result of higher fuel prices in the past have suggested that each price increase of 10 percent causes a reduction in general aviation activity of only 2 percent to 5 percent. Nevertheless, the 85 percent increase in fuel prices necessary to achieve full recovery of air traffic control costs might reduce general aviation activity by as much as 40 percent--enough to bring about a reduction in airport and airway congestion.

## CHAPTER VII. AIRPORTS

*The dominant problem of U. S. airports is congestion: 90 percent of all air passenger volume funnels through just 2 percent (66) of the nation's 3,159 public facilities. Over the 1970-1980 period, the federal share of airport capital costs was 38 percent, or $15.3 billion. To meet expansion needs as estimated under current policy, federal outlays would have to increase nearly twofold. CBO's analysis concludes that these projected needs may be exaggerated for two reasons. First, the strong financial position of major airports and their relatively easy access to nonfederal capital, reinforced by high bond ratings, suggest that the current rather small federal role could be diminished still further. Second, general aviation, especially small aircraft used for business, is heavily subsidized in the use of airports and accounts for a major share of the traffic clogging those facilities. Federal airport expenditures are now fully recovered by charges to users of commercial airlines (as ticket taxes), while general aviation users pay very little. Thus, general aviation is encouraged to use major airports instead of the numerous satellite ("reliever") airports that could accommodate them. Several measures could help redistribute this traffic among existing facilities and/or raise funds to pay for expansion. Passenger fees for terminal use--now prohibited by federal law--and surcharges for peak-hour landings at large airports might somewhat reduce overall general aviation traffic and/or divert it to reliever airports and to off-peak hours of travel.*

### THE PROBLEMS IN AIRPORTS

The United States has more than 15,000 landing places around the country--more than all other nations combined--of which only 3,159 are publicly owned, open for general use, and equipped with at least one paved and lighted runway. Many large commercial airports are operated by independent public bodies with authority to issue bonds. Of these, more than 2,300 (75 percent) are used exclusively by small "general aviation" aircraft--planes owned by individuals or private corporations for business

use or recreation. Only the remaining 780 airports are served by scheduled airlines or by commuter and air taxi operators. Even at many of these, business jets and other general aviation aircraft often account for a major share of take-offs and landings. Since airline deregulation in 1978, another important factor contributing to congestion has been the tendency of many major air carriers to concentrate operations at certain regional hubs.

The nation's number-one airport problems are congestion and delay, which result in millions of dollars of increased operating costs for airlines and wasted time for travellers. As a cause of inefficiency in aviation activity at major commercial airports, congestion appears to outweigh deferred maintenance. Although deterioration has been cited as a problem at small airports, it has not resulted in unsafe flying conditions. 1/ The economic and environmental consequences of congestion are concentrated at a very few major airports. Just 2 percent of all public airports--the 66 largest--serve almost 90 percent of the nation's passenger traffic (see below). At least 11 of these airports already encounter severe traffic traffic congestion or will soon, and traffic growth could soon cause congestion to spread to other airports. At growth rates projected by the Department of Transportation's Federal Aviation Administration (FAA), 23 commercial service airports will be severely congested by the end of this decade and perhaps as many as 46 will be by the end of the century. 2/

The airport congestion problem has two dimensions: space and time. First, because it is concentrated at a few facilities, it leaves other facilities underused--notably, smaller airports ("relievers") within easy flying distance of major ones. For example, nearby Cleveland's Hopkins International airport, five lesser airports are available within a 21-mile radius to relieve congestion at Hopkins. Second, travel schedules converge at peak periods each day, concentrating most landings and take-offs on short peak periods and leaving much of the day relatively free of congestion. To date, few efforts have been made to correct either of these imbalances.

Airport congestion has already exacted high economic costs. In 1980, the airlines spent an estimated extra $1 billion in crew time and fuel, wasted more than 700 million gallons of jet fuel, and delayed airline

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1. See General Accounting Office, Runways At Small Airports Are Deteriorating Because of Deferred Maintenance: Action Needed by FAA and the Congress (September 13, 1982).

2. See Federal Aviation Administration, National Airspace System Plan (December 1981).

passengers by fully 60 million hours. 3/ Unless steps are taken either to increase airport capacity or to improve the use of existing capacity, these costs could double within five to ten years.

## CURRENT POLICY IN AIRPORTS

In 1946, recognizing that an adequate system of airports was a matter of national concern, the Congress authorized the Federal-Aid Airport

| Type of Airport | Number a/ | Percent of Commercial Air Travelers |
|---|---|---|
| | Commercial | |
| Large | 25 | 70 |
| Medium | 41 | 18 |
| Small b/ | 780 | 12 |
| Subtotal | 780 | 100 |
| | General Aviation | |
| Reliever | 155 | No |
| Other | 2,224 | data |
| Subtotal | 2,379 | |
| Total | 3,159 | |

a. Public-use airports with at least one paved and lighted runway.

b. Includes FAA-certified commuter and air-taxi airports.

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3. Congressional Budget Office on the basis of data in General Accounting Office, Aircraft Delays At Major U. S. Airports Can Be Reduced (September 4, 1979), and Mitre Corporation, Survey of 101 U. S. Airports for New Multiple Approach Concepts (September 1981).

Program. Today, the FAA manages the user-supported Airport and Airway Improvement Program, under which the federal government offers airport authorities matching grants of 50 percent to 94 percent for construction and rehabilitation. Federal capital spending on airports is financed by user fees, chiefly levied as taxes on domestic airline tickets and general aviation fuel. These taxes, which originated in 1933 and 1941, were not formally linked to expenditures until 1970, when the Airport and Airways Revenue Act established the Airport and Airways Trust Fund. This fund is supported mainly by an 8 percent tax on domestic passenger tickets and a 14-cents-per-gallon tax on general aviation jet fuel (12 cents for gasoline). 4/ Collections from user fees are distributed to major airports in the form of matching grants determined by a formula based on passenger volume. Collections are distributed to smaller airports in the form of block grants to states. By 1982, the federal government was spending a yearly total of $410 million dollars for airport capital improvements. Over the next five years, it plans to double annual capital expenditures, bringing a year's outlays to $900 million in 1987 (see Table VII-1).

## Total Investment and Trends in Cost Sharing

Since 1960, cumulative investment in the nation's airports have totaled $25.1 billion, of which the federal share accounts for $9 billion, or just above one-third. 5/ These overall data mask wide fluctuations in the year-to-year federal share of total airport investment, however. Between 1973 and 1977, the federal share swung from a post-1970 low of 20 percent to a high of 85 percent (see Figure VII-1). Such swings have resulted from extreme changes in the mix and total volume of airport investment, rather than from shifts in federal outlays, which have remained relatively stable since 1970. Peak investment in 1973, for example, was the result of very large capital outlays by some of the nation's largest commercial service airports, which rely for investment capital on debt financing rather than on the federal government. On the other hand, many small airports, particularly general aviation airports, earn revenues insufficient to cover debt service; these airports tend to rely much more heavily on federal money. In 1977, a year of low overall investment in which much spending probably reflected general aviation airport improvements, the federal share exceeded

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4. The general aviation user fees were increased from 7 cents per gallon under the Airport and Airways Revenue Act of 1970 to 14 cents under the Airport and Airway Improvement Act of 1982.

5. This excludes tax expenditures stemming from tax-exempt bond sales issued by municipal and airport authorities.

TABLE VII-1. FEDERAL CAPITAL EXPENDITURES ON AIRPORTS UNDER CURRENT POLICY (In millions of dollars)

| | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|---|
| All Airports a/ | 402.1 | 532.5 | 785.3 | 886.8 | 989.6 | 902.2 |
| Commercial | | | | | | |
| Large | 100.0 | 138.6 | 204.4 | 230.8 | 233.9 | 234.8 |
| Medium | 53.9 | 74.5 | 109.9 | 124.0 | 125.7 | 126.2 |
| Small | 133.8 | 185.2 | 273.1 | 308.5 | 312.6 | 313.8 |
| Total | 287.7 | 398.3 | 587.4 | 663.3 | 672.2 | 674.8 |
| General Aviation | | | | | | |
| Reliever | 49.1 | 72.4 | 106.8 | 120.6 | 122.2 | 122.7 |
| Other | 65.3 | 61.8 | 91.1 | 102.9 | 104.2 | 104.7 |
| Total | 114.4 | 134.2 | 197.9 | 223.5 | 226.4 | 227.4 |

SOURCE: Congressional Budget Office from data supplied by Airport and Airway Improvement Act of 1982, Surface Transportation Assistance Act of 1982, and Federal Aviation Administration.

NOTE: The categories "large," "medium," and "small" are no longer in use as a basis for distributing federal funds. These designations are used here for convenience only. The distribution of federal funds to airports of different types is not fully specified by law; the figures here are rough estimates, based in part on historical spending patterns. All estimates are preliminary.

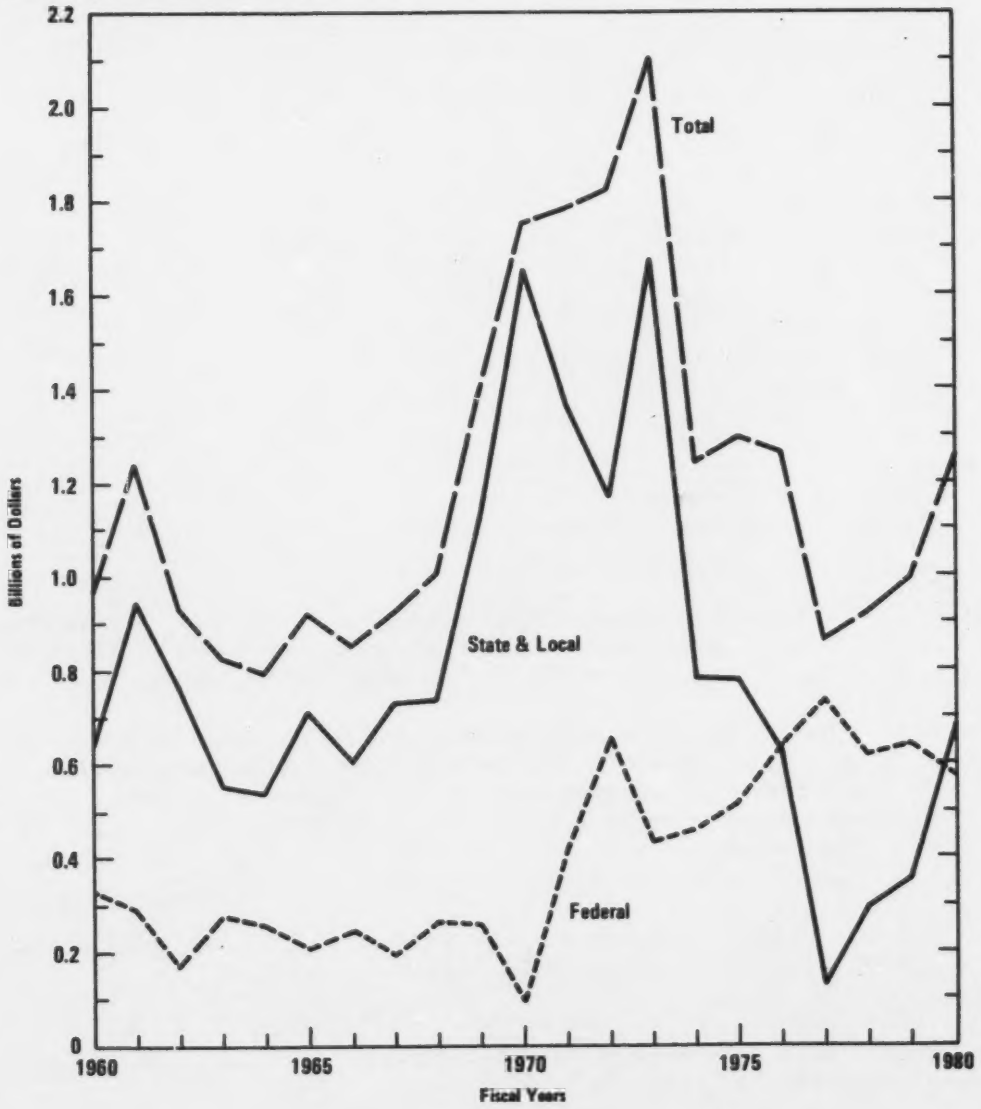
a. Annual budget authority for the years 1983-1987 was $0.8 billion, $0.99 billion, $0.99 billion, $1.0 billion, and $1.0 billion.

80 percent. The state share of airport investment has remained fairly stable since 1970, at about 11 percent. 6/

6. From National Association of State Aviation Officials.

Figure VII-1.

## The Federal, State, and Local Shares of Public Spending on Airports, 1960-1980




SOURCE: Congressional Budget Office based on data provided by Federal Aviation Administration, and U.S. Department of Commerce, Bureau of the Census.

## Federal Expenditures

Although federal airport spending (in constant dollars) has remained fairly stable since 1970 at about $600 million a year, investment has diversified. The federal Airport and Airway Improvement Program targets funds to both air carrier airports and 2,224 general aviation facilities. Moreover, it channels capital grants-in-aid to 155 reliever airports. Active efforts to develop reliever airports lept from zero to $35 million between 1970 and 1980 (see Figure VII-2). Federal investment in general aviation airports also grew steadily throughout the 1970s, and under current policies, outlays in real dollars will triple again by 1987 (see Figure VII-2).

## Major Airport Investment Needs Under Current Policy

The growth in general aviation has been a major factor in the assessment of airport investment needs. Since 1970, the number of general aviation aircraft in use grew by 63 percent to 213,200 in 1982, and the number of hours flown increased by 67 percent. At the same time, with the introduction of wide-body jets, the number of commercial aircraft in use actually declined by 7.8 percent, from 2,690 to 2,483. As a result, general aviation traffic now exerts particular pressure on the capacity of major commercial airports, representing well over half of all landings and departures at many major air carrier airports.

The resulting congestion has led the FAA to project a need for substantial investment in additional airport capacity, upgrading, and maintenance. Together with demand for additional general aviation facilities, annual airport investment needs, according to CBO's preliminary reestimates, will be some $1.5 billion between 1983 and 1990, of which the federal share would be about $0.9 billion. 7/ Of this sum, roughly $1 billion a year would be needed to correct all present and projected deficiencies at air carrier airports; 68 percent of this total would pay for additional capacity (see Table VII-2).

Besides generating investment needs at air carrier airports, the dramatic growth in general aviation would give rise to an estimated annual investment requirement exceeding $500 million if the demand for facilities is to be matched by the supply of general aviation airports. Of this total, about one-quarter reflects maintenance, upgrading, and construction of reliever airports. A further one-fifth represents construction of new airports in small communities where no general aviation facilities now exist;

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7. See Federal Aviation Administration, National Airport System Plan, Revised Statistics, 1980-1989, reestimated by CBO.



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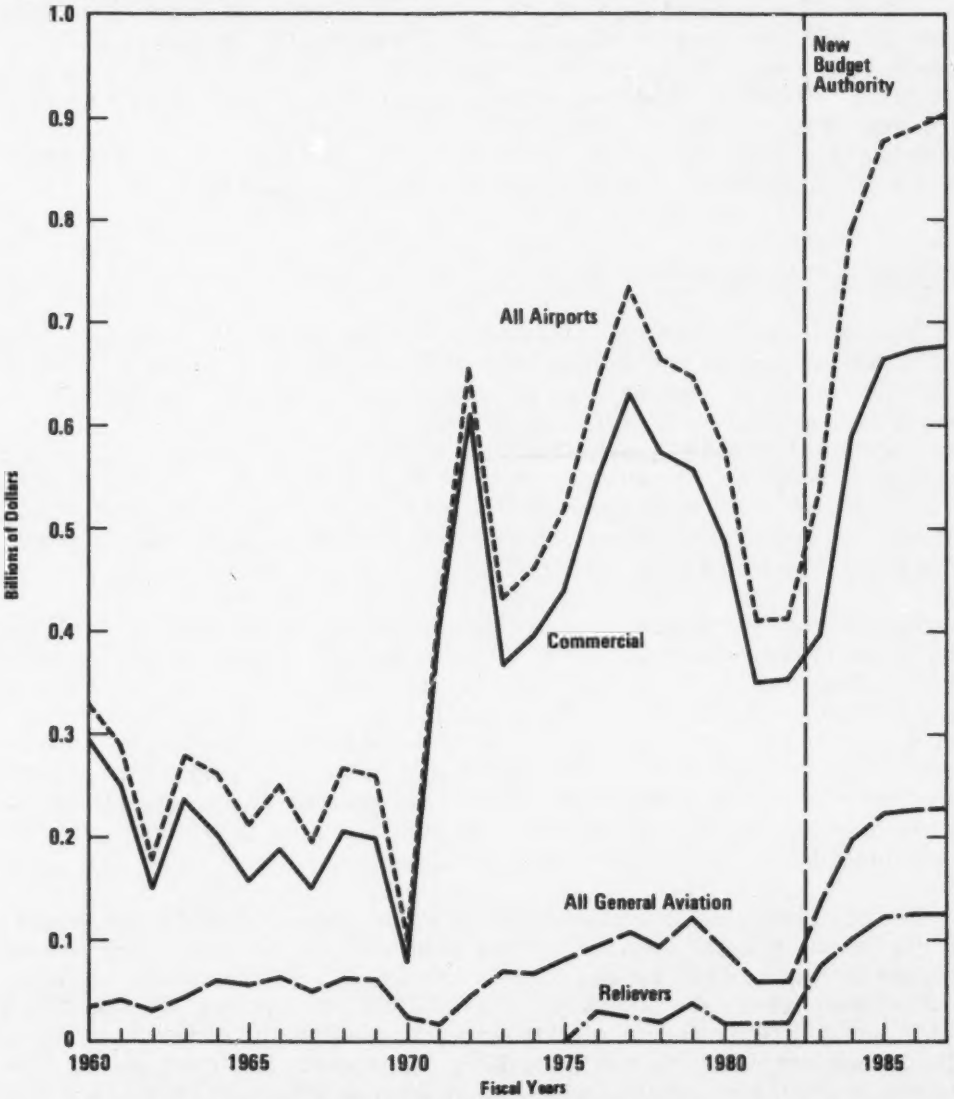
Figure VII-2.

## Actual and Projected Federal Capital Spending on Airports by Type of Airport, 1960-1987




SOURCE: Congressional Budget Office based on data provided by the Federal Aviation Administration.

NOTE: Outlay figures for 1983-1987 are based on authorizations in the Airport and Airways Improvement Act of 1982.

TABLE VII-2. ANNUAL AIRPORT CAPITAL NEEDS, 1983-1990
(In millions of dollars)

| | Expanded Capacity | Upgrading | Maintenance | Estimated Total Needs |
|---|---|---|---|---|
| Commercial Air Carrier | | | | |
| Large | 310 | 55 | 68 | 433 |
| Medium | 149 | 32 | 18 | 199 |
| Small a/ | 230 | 72 | 80 | 382 |
| Total | 689 | 159 | 166 | 1,014 |
| General Aviation | | | | |
| Reliever | 75 | 30 | 15 | 120 |
| Other | 234 | 90 | 63 | 387 |
| Total | 309 | 120 | 78 | 507 |
| All Airports | 998 | 279 | 244 | 1,521 |

SOURCE: Congressional Budget Office reestimates of data in Federal Aviation Administration, National Airport System Plan, Revised Statistics, 1980-1990, and National Aviation System Development and Capital Needs for the Decade 1982-1991 (December 1980), and General Accounting Office, Developing A National Airport System: Additional Congressional Guidance Needed (April 17, 1979).

NOTE: Among the projects included are those not now eligible for federal grants. Ineligible projects include certain revenue-producing components of terminal buildings and hangars (such as duty-free shops and airline maintenance services).

a. Total includes $144 million for small city airports, and $283 million for rural airports. The total for large, medium, and small city airports is $776 million.

these airports would serve primarily private business and recreational planes, and possibly commuter or air taxi operations as well. General aviation investment also includes $175 million a year--35 percent of the total--for additional airplane "tie-downs" (parking places). Tie-down space is sorely lacking at many general aviation airports.

## EFFICIENCY OF CURRENT AIRPORT PROGRAMS

The FAA's projections of airport needs appear overstated when subjected to three questions:

- Would the demand for airport facilities remain as high as it is now if users were charged in proportion to the costs they impose?
- Do all these needs represent facilities of interest to the economy as a whole, or are some of primarily local interest?
- Might nonfederal financing resources prove sufficient to provide the investment capital needed?

### The Demand for Airport Facilities

Airport project investment lends itself especially well to a test of economic efficiency constructed of user fees and users' willingness to pay them. If general aviation users, who have multiplied dramatically under federal subsidies, had to pay the full costs of the airport investments occasioned by that growth, the demand for such investments would probably decline. (As a measure of the magnitude of this subsidy, recovery of all the costs that general aviation imposes on the airport and airways system would require that the taxes paid by private plane owners increase from the current 12 cents per gallon of gasoline and jet fuel to about $1.20 per gallon--see Chapter VI.) Accordingly, if investments were tailored to that diminished demand, fewer airport improvements would be necessary. Conversely, if demand did not decline, then the revenues would be available to pay for these investments, and the federal government, as investor, could reasonably conclude that high economic efficiency had been achieved.

The structure of user fees, however, has as important a part to play in relieving congestion as does the level of fees. Even if all users paid their full share of federal airport investments (as commercial airline users now do), the structure of local user fees could still result in excessive demand for airport expansion. This is because air traffic congestion, and thus pressure to expand airport capacity, occurs daily during periods of peak

demand--usually in the morning and in the late afternoon, when most passengers and general aviation users find it convenient to travel. Local user fees, in the form of landing charges, do not reflect the high capital costs of congestion during periods of peak demand. Rather, landing fees are commonly determined on the basis of aircraft weight and do not vary by time of day (see Table VII-3). 8/ Few airports impose special peak-period fees--a practice used in some other modes of travel in the United States and common abroad--since the existing fee structure has been established in long-term contracts between airport and airline managers, and many such contracts prevent airport managers from levying peak-hour charges. The practice followed by the Port Authority of New York and New Jersey, which operates LaGuardia, Kennedy, and Newark airports, is a notable exception. Peak-hour fees at these facilities, instituted in 1968 by quintupling the off-peak charge (from $5 to $25) and doubling it again in 1979 (to $50), resulted in a marked decline in takeoff and landing delays.

If airports charged higher landing fees during peak periods to reflect the costs of congestion, all users would be encouraged to make use of airport time and space capacity that goes to waste under the current structure of local user fees. Since fees for light planes would increase markedly, many general aviation users would pay increased rates, while others would choose to take advantage of less congested reliever airports. The FAA has estimated that, if peak-hour surcharges were imposed and improvements in air traffic control made (see Chapter VI) simultaneously, some 80 percent of the costs of air carriers delays anticipated at the nation's 25 largest airports over the coming quarter century could be eliminated. 9/ (Again, of course, if travel patterns did not shift as envisioned, increased collections could finance the needed expansion.)

The amount by which the demand for new air carrier facilities might decline is difficult to estimate. Preliminary CBO projections suggest, however, that peak-hour surcharges could significantly delay the need for expansion at air carrier airports. For example, the construction of additional runways might be postponed as long as eight years at Phoenix Sky

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8. To be sure, heavy aircraft, such as large commercial airliners, do cause greater runway wear than do lighter planes, suggesting that weight-based landing fees are a good approximation of the maintenance costs occasioned by each airplane. But this is already reflected in current fees--light planes pay as little as one-twentieth the rates that heavy planes pay, regardless of traffic conditions, as shown in Table VII-3.

9. See Federal Aviation Administration, "Policy Analysis of the Upgraded Third Generation Air Traffic Control System" (January 1977), p. 71.

TABLE VII-3. LANDING FEES AT FIVE MAJOR U.S. AIRPORTS IN 1978, BY AIRCRAFT TYPE (In dollars)

| Aircraft by Type of Use and Passenger Capacity | Atlanta | Los Angeles | La Guardia a/ | Washington National | Denver |
|---|---|---|---|---|---|
| DC-10-30 (Air carrier-- 240-270 seats) | 169 | 81 | 669 | b/ | 111 |
| Boeing-727-200 (Air carrier-- 120-140 seats) | 63 | 30 | 249 | 47 | 41 |
| Boeing-737-200 (Air carrier-- 115-120 seats) | 43 | 21 | 171 | 33 | 28 |
| Swearingen Metro (Air taxi-- 19-20 seats) | 7 | 3 | 27 | 5 | 5 |
| Learjet 25B (General aviation-- 8 seats) | 6 | 3 | 25 | 5 | 3 |

SOURCE: Congressional Budget Office from General Accounting Office, Aircraft Delays at Major U. S. Airports Can Be Reduced (September 1979).

a. Reflects peak-hour charge imposed at airports run by the Port Authority of New York and New Jersey.

Harbor Airport, up to five years at Memphis International, and three years at San Diego's Lindbergh Airport. As Table VII-4 demonstrates, the length of time of potential postponements in expansions correlates directly with the portion of each airport's use accounted for by general aviation.

TABLE VII-4. SELECTED POTENTIAL AIRPORT EXPANSION POSTPONEMENTS AS A FUNCTION OF GENERAL AVIATION USE

| Airport | General Aviation Share of Total Operations (1981) | Estimated Postponements with General Aviation Paying User Fees Set at Full Cost Recovery |
|---|---|---|
| Phoenix (Arizona) Sky Harbor | 58 percent | 8 years |
| San Diego (California) Lindbergh | 31 percent | 3 years |
| San Jose (California) Municipal | 84 percent | 7 years |
| Denver (Colorado) Stapleton | 21 percent | 2 years |
| Ft. Lauderdale (Florida) International | 64 percent | 4 years |
| Nashville (Kentucky) Metropolitan | 61 percent | 5 years |
| Detroit (Michigan) Metropolitan | 25 percent | 5 years |
| Cleveland (Ohio) Hopkins | 37 percent | 3 years |
| Memphis (Tennessee) International | 45 percent | 5 years |

SOURCE: Congressional Budget Office, adapted from Federal Aviation Administration, Analysis of Non-Capital Alternatives for Handling General Aviation Activity at Busy Airports (August 1977).

NOTE: Estimated postponements based on anticipated dates when current airports will be operating at full capacity ("saturation") and assumes reliever airport capacity to be adequate.

## National Significance of Airport Needs

Not all the airport needs reported in Table VII-2 necessarily represent investments that would contribute to a nationwide system of interconnected air routes. Of the 780 air carrier airports, only 66 are needed to serve the bulk of all commercial airline traffic. And of the 2,379 facilities serving general aviation, only the 155 reliever airports are needed to help reduce congestion at major air carrier facilities. The remaining 2,224 general aviation airports in the National Airport System Plan serve needs that are primarily local. A general aviation airport qualifies as having "national significance"--the criterion for inclusion in the federal plan and eligibility for aid--if it is publicly owned, accommodates a certain minimum aircraft load, and serves a community located 30 minutes or more in flying time from another existing or proposed airport in the plan. 10/ This definition does not take account of the nature of traffic served, and it allows the inclusion of a major share of the nation's public-use general aviation airports. Altogether, investments in the 2,224 general aviation airports of primarily local interest account for $387 million (or more than three-fourths) of the $506 million annual investment needs the FAA projects. This implies that a significant portion of the federal investment in general aviation airports would be eliminated under a more restrictive definition of "national significance."

## Financial Self-Sufficiency

Financial condition can be an important determinant of need for federal aid. Airports differ markedly from one another in their need for federal aid to finance capital improvements. As a rule, larger air carrier airports are in better financial shape than smaller ones. Though they do not have the financial standing to obtain credit or carry sizable debts, nonetheless general aviation airports appear to have considerable unused revenue-raising potential from users rather than debt markets.

Large Air Carrier Airports. More than half the total annual estimated airport needs--up to $776 million a year--occur at air carrier airports that appear able to finance themselves; in the past, these facilities have relied on federal aid only to a small degree. Direct federal funds now appear to account for 20 percent or less of total investment monies at large

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10. The minimum load capacity stipulated by the FAA is based not on number of aircraft but on number of engines, and the minimum standard is ten engines. The standard thus allows ten single-engine planes (usually 2-4-seaters), five twin-engine planes (4-8-seaters), and so forth. These standards are currently under review by the FAA.

airports, the balance being drawn primarily from the issuance of tax-exempt revenue bonds, retained earnings, and other nonfederal sources. 11/ By contrast, the revenue generated at many public-use airports is insufficient to make any payments toward capital investments.

In general, the larger air carrier airports appear able to meet their debt service requirements from operating income from such sources as landing fees, terminal concessions, and parking revenues. 12/ This is because airport costs represent only a very small share of total airline operating expenses, giving airport managers considerable leverage to increase fees in order to finance capital improvements. Thus all large and medium-sized airports carry bond ratings graded in the Baa to Aaa category, meaning that they are regarded as good investments with little speculative risk.

Despite the traditional financial well-being and favorable position of major airports in the tax-exempt bond market, airport managers must compete in financial markets in which uncertainty about interest rates and demand for tax-exempt bonds are high. 13/ Against these odds, airport managers nonetheless are finding ways to maintain access to private investment. Three such strategies stand out: use of taxpayer credit, improved bond marketability through "creative finance," and improved flexibility for timing the issuance of long-term debt. Short-term trends indicate some success with these strategies at many large airports. Although ten airport revenue bonds were issued in 1981--two fewer than in 1980--the dollar volume increased a significant 63.7 percent, from some $339 million in 1980 to $555 million in 1981. It is noteworthy that the volume of bond sales in 1981 was roughly equivalent to projected annual needs at large and medium-sized airports, as reported in Table VII-2, indicating that the airport bond market is fully capable of supporting a large expansion program.

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11. These estimates are preliminary. Further analysis is being conducted for forthcoming CBO study on airport financing.

12. See Federal Aviation Administration, Investment Needs and Self-Financing Capabilities: U. S. Airports, Fiscal Years 1981-1990 (July 1978), and The Airport Passenger Head Tax, Analysis of its Potential Impact (July 1974).

13. See Roger H. Bates, Airport Financing: Whither (or Wither) the Market, 1982 Airport Operators Council International Economic Speciality Conference, Sacramento, California (March 31, 1982).

Longer-term trends are more difficult to gauge. On the one hand, two importantant developments--federal deregulation and rising fuel costs--seem to have had little negative impact on most large airports' finances. Analysis indicates continued growth in net revenues and maintenance of generally adequate coverage of debt service on airport revenue bonds. Some airports, usually medium-sized and large ones, have actually benefited from deregulation and the resulting ease of access to travel markets for certain carriers. On the other hand, airline deregulation might actually increase borrowing costs at certain airports, diminishing access to private capital. This is because deregulation released airlines from all obligations to serve any particular airports. In response, bond-rating agencies (Standard and Poor's and Moody's) have started rating the creditworthiness of airports on the strength of local economic bases, not simply on the basis of use by financially stable airlines. The rating agencies reason that, if one airline withdraws service, a strong local economy would simply attract other airlines to pick up the travel business. Conversely, airports in parts of the country that are in relatively weaker economic shape might now represent more speculative investments than they did before deregulation. 14/

Regulatory barriers to increasing rates and charges could also hamper the ability of air carrier airports to take full financial responsibility for all needed development, even at the financially strongest air carrier airports. Airport managers have little control over the structure and level of charges. For example, the "head tax"--a charge to each passenger for use of terminal facilities--was banned by the Congress in 1973, in part because some cities were diverting airport revenues to help finance other unrelated investments. 15/ Revenues from other major sources are established in binding leases and contracts for specified periods of time, sometimes longer than 20 years. Only as leases and contracts expire do opportunities to raise rates and charges arise. For concession contracts, the extent of the opportunity depends on market forces. Concessionaires bid on concession contracts, and airport managers are not in a position to demand any specific level of revenue.

Despite these obstacles, the financial needs at large air carrier airports need not be equated with requirements for federal aid. Although regulatory barriers to the application of certain user fees could prevent some airports

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14. For example, the bankruptcy of Braniff Airways in 1982 had no impact on the bond ratings of Dallas-Fort Worth International Airport; ratings held firm presumably on the growing strength of southwestern economies.

15. Under the Airport Development Acceleration Act of 1973.

from financing all planned development, airlines might be willing to renegotiate contracts if the advantages seemed worthwhile. Exceptions to these conclusions might apply in the case of airports located in declining regions or those experiencing unforeseen financial difficulties.

Small Air Carrier Airports. Though most large air carrier airports appear financially able to meet their own capital needs, the smallest air carrier airports cannot. Changes in the bond rating process reviewed above make small airports in thin travel markets even greater credit risks than they used to be before airline deregulation. And any action by such airports to raise landing fees to finance airport improvements could lead the airlines to withdraw service. Of course, unwillingness to pay on the part of airline managers could signal that the proposed improvements are not economically attractive. But many of these smaller airports serve small rural communities, and reductions in airline service could hasten those areas' economic decline. Federal assistance might thus be justified as a means of preserving regional balance. Though the precise number of air carrier airports in this position is difficult to estimate, they probably account for $150 million to $240 million of the improvement needs--10 percent to 16 percent of total needs displayed in Table VII-2.

General Aviation Airports. General aviation airports--with their low landing fees and tie-down charges--offer the greatest opportunity to move toward self-financing of capital improvements. Many of these airports, though publicly owned, are operated and managed by private operators who charge for their services and remit a portion of their revenues to the airport owners. Although general aviation users have cause not to welcome landing fees, many of the airports they use could substitute such local fees for federal grant assistance.

Exceptions might apply in the case of general aviation reliever airports, especially those that present direct competition to major commercial airports. Major airports attract general aviation business by offering services superior to those available at most reliever facilities (better runway lighting and landing aids, for example), while charging users less than their associated costs, especially during peak periods. This attraction shrinks the revenue base of reliever airports, diminishing their ability to compete by improving service; it also adds pressure to expand runway capacity at commercial airports, even though capacity already exists at nearby reliever facilities. Although charging higher fees at commercial airports would be the most direct means of correcting this imbalance, to the extent that federally subsidized development at reliever airports encouraged

general aviation users to switch, there might be an economic advantage in offering such subsidies. 16/

## FEDERAL STRATEGIES TO IMPROVE AIRPORT INVESTMENT

Under current policy, total federal grant monies to airports would average $800 million a year between 1983 and 1987. Although the FAA projects that revenues from user fees would suffice to cover the full costs of all these federal expenditures, general aviation users would be heavily subsidized by commercial airline passengers. As a group, general aviation users would pay less than one-fifth of their allocated share of federal airport costs. Currently authorized grants for airport development would cover roughly half the nation's annual air carrier and general aviation airport investment needs as estimated by the FAA. The 66 largest air carrier airports--those handling nearly all commercial passenger traffic--appear financially able to meet at least the remaining 50 percent of their annual capital needs, which are estimated to total $200 million; without federal assistance, these airports could probably self-finance a great deal more development than they now do. Thus there is no compelling evidence that finances would stand as a barrier to airport development under current policy. (Other barriers might still exist, of course. In many cases, for example, land suitable for airport development may not be available.) Nevertheless, the inefficiencies inherent in current policy--notably, the heavy subsidization of general aviation--suggest consideration of other strategies.

### Eliminate Federal Assistance and Permit Greater Application of User Fees

One strategy for shifting federal airport policy would entail withdrawing federal airport grants, enabling air carrier airports to charge for use of passenger facilities (that is, reinstating head taxes), and allowing imposition of peak-hour surcharges.

Budgetary Implications. This course would eliminate the federal government's direct financial role in airport development, saving the government the full $800 million it is projected to spend each year until 1987. Offsetting this gain, however, federal tax expenditures through the

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16. In economic jargon, this is equivalent to "second-best" pricing as a means of offsetting a market externality; see S. Glaister, "Generalized Consumer Surplus and Public Transport Pricing," The Economic Journal (December 1974).

exemption of airport revenue bonds would increase to the extent that airport operators used bond financing to substitute for federal aid. Federal user fees for airport development could be eliminated, although the federal government would continue to charge for use of the air traffic control system (see Chapter VI).

Without federal financing, the funds for capital investments would have to come from airport contributions and increased debt issuance, or both. In either case, local user fees would have to rise. Federal measures that allowed charges for use of passenger facilities (head taxes) and peak-hour surcharges could provide airport authorities with the means to substitute local for federal user fees. For small airports, however, state and local governments might be expected to subsidize airport development to some extent to avert the losses of service that could result from higher fees.

Effects on Airport Adequacy. Withdrawing federal aid and permitting airport managers to impose variable landing fees (peak-hour pricing) could lead to substantial improvements in the use of existing airport capacity. Since delay problems tend to be concentrated during certain hours of the day, peak-hour surcharges could disperse peak demands and increase use of idle time and space now available during off-peak hours and at reliever airports. If demand were not reduced, however, the increased revenue would finance the expansion needed to reduce peak-hour delays. Overall, the FAA projects that peak-hour pricing could significantly reduce the cost of air carrier delays anticipated at the largest airports for the next decade. 17/

In combination, congestion fees and reinstatement of head taxes could strengthen the financial performance of air carrier airports. 18/ This would improve airport managers' access to private capital and put them in a position to raise more funds for airport expansion than they could under the current system of federal grants.

This strategy could also improve efficiency in the use of general aviation airport capacity and in the use of investment funds for further development. In the past, general aviation airports have relied heavily on federal grants for capital improvements, although there is little economic

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17. See Federal Aviation Administration, The Upgraded Third Generation Air Traffic Control.

18. Airline operators have opposed reinstatement of head taxes in large part because of apprehension that these charges might be high enough to discourage air travel.

justification for this in view of these facilities' revenue-raising potential and limited contribution to a national transportation system. A withdrawal of federal aid would provide an incentive to general aviation airport managers to levy appropriate user fees. If the primary beneficiaries--the users of these airports--did not find it worthwhile to finance further development through such user fees, then the demand for such services would diminish.

Impacts on Users. Higher landing fees and head taxes would have different implications for different user groups. Commercial airline passengers would probably see little effect on fares; a head tax might range from $1 to $5. Moreover, since airlines schedule flights when they think passengers want to fly, they would probably be willing to absorb moderate increases in peak-hour landing fees to continue using the airports at those times. In the context of the total operating costs of a large jetliner, even a sharply increased landing fee of several hundred dollars per landing would be small when divided among a large number of passengers.

General aviation users, in contrast, would be more sensitive to increases in landing fees. Peak-hour landing fees at New York's Kennedy and LaGuardia are already known to have resulted in a 30 percent decrease in general aviation traffic at those airports, though it is not known how many trips were curtailed, made by other means (such as commercial airlines), or diverted to reliever airports. 19/ Some personal cost and inconvenience seem inevitable, however, particularly to recreational users of general aviation facilities.

## Selective Federal Assistance

A strategy of selective federal assistance could include the provisions of the one above but would add federal mechanisms to avert risks of regional imbalances in airport development. Under this diminished but not totally withdrawn federal role, federal matching grant money could be disbursed for three purposes: for large and medium-sized airports that face difficulty in obtaining bond financing; for small rural air carrier (including air taxi and commuter) airports; and for general aviation reliever airports.

Budgetary Implications. Direct grants might total roughly $300 billion a year, about 36 percent of currently planned spending. Because of the healthy financial condition of most major airports--and the added revenue

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19. See Office of Technology Assessment, Airport and Air Traffic Control System (January 1982).

yield of head taxes and congestion fees--the total volume of federal grants for these airports could be reduced substantially.

Effects on Users and Airport Finances. As compared to current policy, such selective federal assistance would permit the commercial ticket tax to fall by more than 60 percent. General aviation fees, however, would have to be increased if the full cost of general aviation's use of federally financed airport development were to be recovered. The extent of this increase would depend on the costs of air traffic control, since aviation user fees cover these as well as airport-related costs.

Effects on Airport Adequacy. Direct grants to certain airports might help foster regional development in economically declining areas. This would result from federal grants' encouraging more commercial air service than the market itself would support. Selective federal aid to upgrade the nation's 155 general aviation reliever airports--particularly in conjunction with congestion fees--might help divert general aviation users away from now overburdened air carrier facilities.

## CHAPTER VIII. MUNICIPAL WATER SUPPLY

*Despite clear indications of physical and financial problems in the nation's municipal water supply systems, the CBO analysis points to no need for any appreciable expansion of the now small federal role. Federal outlays for municipal water systems totalled about $900 million in 1982. Physical problems are characterized as deterioration of existing distribution facilities, inadequate treatment facilities, and insufficient capacity to meet projected population growth. Overall funding to remedy these problems in the 756 urban systems that serve the most densely populated areas would total $6 billion to $9 billion a year by 1990. Up to 95 percent of these needs could be met with increased consumers' rates, many of which are now held at very low levels, and with a variety of state and local financing sources to which many water authorities might have access if certain barriers were overcome. The emphasis of such federal aid as is now provided seems properly targeted toward federal concerns--toward urban areas in fiscal distress and impoverished or thinly populated rural areas.*

### THE PROBLEMS IN MUNICIPAL WATER SUPPLY

Of the 756 urban water systems that serve city populations of 50,000 or more, 552 are publicly owned and 204 are investor-owned utilities; together, these systems provide water for 54 percent of the U.S. population. 1/ About 58,000 community systems serving smaller populations provide water to another 30 percent of the U.S. population. Another 15 percent of the population have their own water wells. The last 1 percent have no piped water supply. 2/ The systems that furnish potable water in

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1. See The President's Intergovernmental Water Policy Task Force, Subcommittee on Urban Water Supply, Urban Water Systems: Problems and Alternative Approaches to Solutions (June 6, 1980).

2. See Water Resources Council, The Nation's Water Resources 1975-2000, Volume I: Summary, Second National Water Assessment by the Water Resources Council (December 1978).



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the United States have three components: supply works (reservoirs, well fields, or river diversions), treatment works, and distribution networks. Problems affecting municipal water supplies fall into the categories of physical and financial.

## Physical Condition of Facilities

Because no comprehensive nationwide assessment has been made of the physical condition of community water supply systems or of their need for capital improvements over the next decade, generalizations cannot be made with any confidence. Anecdotal reports on the physical condition of water supply systems suggest three types of problems, but no consensus has been reached regarding the severity of these problems.

Deteriorated or Inadequate Distribution Systems. A 1979 study by the General Accounting Office (GAO) notes water leakage losses of up to 46 percent of total water supplied in one city (Scranton, Pennsylvania) resulting from cracked distribution mains or poor conduit joints. 3/ Other cities also reported high losses: Boston, 43 percent; New Orleans, 36 percent; Wilkes-Barre, Pennsylvania, 35 percent. A 1980 study, in contrast, set the average leakage loss in 21 city systems at only 9 percent of water supplied. 4/ No standard exists to determine what an economically acceptable percentage loss might be; for some systems, developing and pumping additional supplies--albeit through leaky distribution systems--may be more economical than undertaking repairs. Clearly, though, such losses as these will increase if regular maintenance and rehabilitation continue to be neglected.

The Need for New Sources of Supply. One recent study concluded that about 23 percent of all U.S. cities with populations above 50,000 will require new sources of water supply by 1990. 5/ This estimate was based primarily

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3. See General Accounting Office, Water Supply for Urban Areas: Problems in Meeting Future Demand (June 15, 1979).

4. See Nancy Humphrey and Peter Wilson, Capital Stock Condition in 28 Cities, report prepared for the Urban Institute (February 15, 1980).

5. See SMC-Martin Consulting Engineers and Temple, Barker, & Sloane, Inc., An Analysis of the Nation's Urban Water Systems: Characteristics, Investment Requirements and Policy Options, report prepared for the Institute for Water Resources, Department of the Army (February 29, 1980).

on patterns of consumption and estimates of projected population growth. Rehabilitation or replacement of water mains and new conservation efforts were not taken into account, however. The former can prevent large leakage losses, and the latter can reduce consumption; together, these measures can obviate or at least forestall the need for new water supplies.

Inadequate Treatment Facilities. One measure of the adequacy of raw water treatment is compliance with the Environmental Protection Agency's (EPA) drinking water standards for bacteria and other contaminants. In 1980, 97 percent of all community water systems (serving 84 percent of U.S. population) met the standards for bacteria, and 89 percent met the standards for turbidity (suspended solid matter). 6/ No federal health standards exist for many of the synthetic organic compounds--industrial wastes--found in drinking water, though many, in high concentrations, are known or suspected carcinogens. Data on the occurrence of these substances are not routinely collected, but in many instances when drinking water supplies have been tested, these compounds have been found at alarmingly high levels. 7/ Estimates of new treatment facility needs may not take account of expenditures to remove organic toxins.

## CURRENT POLICY IN WATER SUPPLY

Developing municipal water supply has traditionally been a local responsibility, and the federal role has been small. In 1982, the combined federal expenditures for municipal water supply amounted only to an estimated $900 million, while all state and local jurisdictions together spent an estimated $11.6 billion for water supply capital and operating expenses (see Figure VIII-1). Since 1960, annual combined state and local spending for municipal water supply has fluctuated between $8 billion and $11 billion, but in the last decade, it has increased at a consistent annual rate averaging 4 percent. The federal role has remained limited. Rural areas receive federal assistance through a grant and loan program for water and sewer systems administered by the Farmers Home Administration (FmHA), and economi-

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6. See Environmental Protection Agency, "A Status Report--The National Public Water System Program," Office of Drinking Water (May 1982).

7. In 1979, one-third of Massachusetts' communities were affected by chemical contamination of drinking water. In 1980, 37 public wells in 13 cities were closed in California because of chemical contamination. For many more examples and additional details, see Council on Environmental Quality, Environmental Quality--1980, pp. 81-135.

Figure VIII-1.

## Federal and Nonfederal Spending on Municipal Water Supply, 1960-1982

SOURCE: Congressional Budget Office from data provided by the U.S. Department of Commerce, Bureau of the Census.

[a] Actual state and local data for 1980-1982 not available.

cally depressed areas through grant and loan programs administered by the Economic Development Administration (EDA), the Department of Housing and Urban Development (HUD), and the Appalachian Regional Commission (ARC).

Since its authorization in 1926, the FmHA rural grant and loan program has been the most important of the federal single-purpose water supply assistance programs, with annual loan and grant funding ranging from $400 million to more than $1 billion. 8/ Federal funds are available to all public entities below the state level with populations of 10,000 or less; these monies can be invested in installation, repair, improvement, or expansion of rural water facilities, but they cannot go toward operation or maintenance of existing works. In place of loans, the federal government offers direct project grants with no local matching requirements, but only to reduce user charges to what federal authorities deem a "reasonable" level, based on the ratio of debt service to median local income. Funds are allocated to states on the basis of rural population and number of households with annual incomes at or below the federally established poverty level.

The federal government also helps states and localities by including water supply storage under two general water resources development programs administered by the U.S. Army Corps of Engineers and the Department of Interior's Bureau of Reclamation. These agencies do not develop single-purpose water supplies, but they may add municipal water supply storage to multipurpose water projects (primarily impoundments for flood control, navigation, hydroelectric power, irrigation, and recreation). As of 1979, these two agencies together had invested about $225 million to provide municipal water storage in completed reservoirs, and they will invest another $746 million for storage in reservoirs that are under construction or planned. 9/ Under the Corps of Engineers and Bureau of Reclamation programs, the federal government effectively pays 46 percent and 29 percent, respectively, of combined construction and operating costs of providing municipal water supplies. 10/

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8. About $2.60 in loans were made for every $1 in grants since 1975. Before that, the ratio averaged about 11:1.

9. See General Accounting Office, Contracts to Provide Space in Federal Reservoirs for Future Water Supplies Should be More Flexible (May 16, 1980).

10. See Water Resources Council, Options for Cost Sharing: Implementation and OM&R Cost Sharing for Federal and Federally Assisted Water and Related Land Programs, Part 5A (November 1975).

Local Financing and the Adequacy of Municipal Water Supply

The key issue in municipal water supply is whether local authorities can pay for needed projects. The weak financial condition of many systems has resulted in postponed maintenance and ultimately, in higher repair costs. Between 1968 and 1977, water supply revenues for all community water systems increased at an 8 percent annual rate, while expenditures for these systems increased 10 percent a year. Either this 2 percent annual deficit in operating expenses was compensated by federal payments to states (which increased 17 percent a year between 1968 and 1977), or systems went farther and farther into debt. One way city managers chose to handle this operating deficit was to cut back on maintenance despite growing maintenance needs. Again, no comprehensive data adequately document a trend toward deferred maintenance on a national basis, but in 19 major U.S. cities, between 1973 and 1978, the average water system maintenance workforce was cut back by about 10 percent (11 cities cut back; four remained the same; four increased their workforces). 11/

One trend does seem clear: privately owned systems, which charge 71 percent more for water than do municipal systems, have generally been better able to increase rates to meet escalating operating costs than have public systems. In general, public pressure has kept water rates low in systems that are operated as divisions of, or in close association with, municipal governments. In 1978, only 5 percent of all privately owned systems operated with a deficit, and this gap averaged only 2 percent of revenues. By contrast, 13 percent of all publicly owned systems operated with deficits, averaging 14 percent of revenues. 12/

With regard to the capital needs that result from deferred maintenance and from new requirements, marked differences between public and private systems also emerge. In 1978, the public water utilities financed their capital needs from four sources: retained earnings (36 percent); debt (26 percent); connection fees (35 percent); and intergovernmental grants and transfers (3 percent). Private water companies, in contrast, financed their capital needs by relying more heavily on retained earnings (51 percent) and debt (32 percent), and less heavily on connection fees (16 percent). In addition, privately owned water utilities raised 1 percent of their capital in 1978 by issuing stock.

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11. See Humphrey and Wilson, Capital Stock Condition, p. 11.

12. See SMC-Martin and Temple, Barker, & Sloane, "The Nation's Urban Water Systems," pp. 27-28.

## Major Investment Needs

Total annual needs for the 756 urban systems were estimated to be between $6.3 billion and $9.1 billion for the period 1980-1990, as shown in Table VIII-1. On the basis of population-adjusted extrapolations to all community systems, CBO estimates that annual capital needs would be between $10 billion and $15 billion. These water supply investment needs fall into three categories: replacement and rehabilitation of existing systems, servicing new growth, and new source development.13/

Replacement and Rehabilitation. The treatment and distribution components of many urban systems have now reached the end of their useful lives. In several large northeastern cities, where water mains have been in service for a century or longer, leakage losses of up to 40 percent are common. But such problems can occur regardless of age. Water losses result from corrosive soil chemistry, harsh weather, ground vibration, and the limited lifespan of materials; over time, these factors take increasingly heavy tolls. For the 756 urban systems, between $63 billion and $100 billion will be needed by the year 2000 to replace all water mains older than 90 years and to rehabilitate others as necessary. Extrapolations to all community systems (again, adjusted for population variations) suggest that total replacement and rehabilitation needs for all communities could run as high as $100 billion to $160 billion by the year 2000.

New Growth. Servicing new growth includes providing new water mains to developing suburbs or increasing the size of mains to accommodate increased population density accompanying center-city redevelopment. Developers may be required to pay the direct costs of servicing new growth (laying new water mains or tapping into existing mains), but indirect costs (pumping stations, additional pumping costs, extra storage, and treatment) are shared by all customers. To provide service to expanding populations for the 756 urban systems by 1990, between $6.1 billion and $9.6 billion would

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13. For additional detail, see The President's Intergovernmental Water Policy Task Force Report, Urban Water Systems: Problems and Alternative Approaches to Solutions (June 6, 1980). "Needs" were estimated independently within three categories. Replacement and rehabilitation needs estimates were based on age of components, leakage, and standard life estimates. Estimates of servicing new growth needs were based on the cost of new connections, on treatment plant expansion costs per incremental population increase, and on population projections. Estimates of new source development needs were based on population projections and/or maximum sustainable water delivery estimates for a cross-section of existing systems.

TABLE VIII-1. ESTIMATED ANNUAL CAPITAL NEEDS BY 1990--SHORTFALLS AND REGIONAL IMPLICATIONS FOR 756 URBAN WATER SUPPLY SYSTEMS

| Category | In billions of dollars: Annual Capital Needs | In billions of dollars: Annual Shortfalls a/ | Locations of Greatest Need |
|---|---|---|---|
| Replacement and Rehabilitation of Existing Systems | 3.2-5.0 b/ | 0.3-0.4 | 40 percent in Northeast |
| Servicing New Growth | 0.6-1.0 c/ | 0.2-0.3 | Southeast, Southwest |
| New Source Development | 2.5-3.1 c/ | 0.4-0.5 | Southeast, Southwest, West |
| Total | 6.3-9.1 | 0.9-1.2 | |

SOURCE: Adapted by the Congressional Budget Office from data in The President's Intergovernmental Water Policy Task Force, Subcommittee on Urban Water Supply, Urban Water Systems: Problems and Alternative Approaches to Solutions (June 1980).

a. Defined as that portion of the capital investment that cannot be financed based on projected expenditures and on revenue increases up to a doubling of present rates.

b. Annualized from a 20-year estimate (1980-2000).

c. Annualized from a ten-year estimate (1980-1990).

be required. Extrapolating to all community systems, this range could increase to $9 billion to $15 billion.

New Water Sources. As population and related economic activity burgeon, providing new water supplies to meet additional demand can become increasingly difficult and expensive. Degradation of natural water quality can preclude the use of some drinking water sources. Growing competition for readily available surface and groundwater supplies from

agriculture and industry can further complicate new source development. Environmental effects or public reaction against new impoundments or long-distance water transfers may also hamper new source development. Of the 756 urban systems, an estimated 170 will require an additional water supply by 1990 at an investment of between $25 billion and $31 billion. This range could increase to $40 billion to $50 billion if all community water systems are considered.

### Shortfalls in Municipal Water Supply Investment Under Current Policy

The annual "shortfalls" in water supply investment that might occur under current policy are displayed in Table VIII-1. If a water system were unable to finance its needs (replacement, rehabilitation, expansion, or new source development) even after rate increases up to 100 percent, then a shortfall would occur. (A doubling of water rates is an arbitrary cut-off point, chosen simply to illustrate the possible magnitude of investment need. Shortfall estimates are based on incomplete data and may vary as much as 100 percent.)

Of the total annual needs estimated for the 1980-1990 period ($6.1 billion to $9.1 billion), about $0.9 billion to $1.2 billion may be considered annual shortfalls under this definition. Expressed as a percentage of need, the greatest potential for shortfalls emerges in the second needs category--servicing new growth--in which as much as 30 percent may be lacking. But the dollar value of estimated shortfalls in this category is low. New source development in the Northeast, Southwest, and West together could generate the highest shortfall--between $400 million and $500 million a year. In general, publicly owned systems seem four times as likely as privately owned systems to experience shortfalls. This is not surprising, in view of the fact that private systems, on average, charge 71 percent more for water than do public ones.

## EFFICIENCY OF CURRENT MUNICIPAL WATER PROGRAMS

Growing requirements of municipal water supply systems need not entail an increased commitment of federal resources. In fact, current federal programs appear well matched both in size and direction to federal responsibilities. Federal aid is targeted to economically depressed urban areas in which populations may not be able to pay high costs to meet water supply needs and to rural communities in which the costs of serving a dispersed population can be prohibitive. In such situations, federal loans or grants are probably warranted both from an efficiency and an equity perspective. Though increased federal spending could help local govern-

ments meet their water supply capital needs over the next decade, the resources available directly to state and local jurisdictions are likely to be sufficient in most cases. Increased federal aid could divert resources away from other federal interests and possibly substitute for local capital. Local decisions on commitment of local funds, on the other hand, tend to favor the most cost-effective solutions. Local decisionmaking can also avoid some cumbersome administrative delays and costs associated with federal aid. Alternatives available at the local level--rate reform, water conservation, growth-related charges, and greater use of existing capital markets--could probably meet up to 95 percent of estimated needs.

## FEDERAL STRATEGIES TO IMPROVE MUNICIPAL WATER SUPPLY INVESTMENT

The federal government can choose between maintaining its now small role in municipal water supply or adopting an alternative course that would increase federal spending in those few areas where state and local initiatives prove inadequate. Even within the context of current policy, however, changes at the state and local--not the federal--level might improve the efficiency of investment. Although the current federal effort in water supply is well matched to meeting future needs from an economic efficiency perspective, its continuation implies changes in the ways that states and local jurisdictions conduct their business.

### Rate Reform

Water rates are low in the United States for no intrinsic reason. In fact, in most instances when utilities face new investments to expand service, there are good reasons to consider rate increases first. As with other services, low rates for water lead to high consumption, at times calling for unnecessary investment in new supply or added treatment and delivery costs. This can be construed as a signal of economic inefficiency. In the United States, where water rates average about $1.00 per 1,000 gallons, consumption is about 100 gallons per person per day. In European countries, where water rates are generally more than twice U.S. rates, daily per capita consumption is about half the average U.S. level (Germany-37 gallons; Sweden--54 gallons; France--30 gallons; the United Kingdom--53 gallons). 14/

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14. A typical rate can be found in Frankfurt, Germany, where consumers pay a rate of about $2.80 per 1,000 gallons.

Over the past ten years, the United States' public water utilities have had difficulty raising water rates to keep pace with increases in operating expenditures. Four main influences have kept rates low: eroding city tax bases, economically depressed service areas, consumer resistance, and political pressure. So, though rate reform may be the utilities' single most important capital formation measure, rate increases must be considered on a case-by-case basis, taking the social, political, and economic environment of each municipality into account. Where a municipal water administration is closely linked to, or even a branch of, municipal government, both rate increases and the earmarking of the resulting revenues for water supply investment may be difficult to achieve.

One recent estimate for the 756 urban water systems suggested that between 87 percent and 90 percent of the identified water supply needs (see Table VIII-1) could be accommodated with rate increases no greater than twice current rates. 15/ Even if this estimate is overoptimistic by 50 percent, this option alone would reduce all water supply needs by almost half. The remaining systems would probably experience shortfalls because of four factors: underlying economic barriers (that is, economically depressed service populations unable to pay higher rates); low bond ratings, which impede access to debt-generated capital; political resistance to increased rates; or statutory limitations on incurring debt or raising revenues. For systems encountering these obstacles, different strategies might be appropriate.

## Water Conservation

Water conservation programs can reduce capital shortfalls in two ways. First, for systems facing new source development needs, a water conservation program can reduce demand enough to forestall the need for new supply, extending the time communities have for capital formation. Second, water conservation can reduce demand and thus the capital needs to develop new sources of supply. For example, the East Bay Municipal Utility District in San Francisco, faced with a drought-caused water shortage in 1977, undertook new source supply development and imposed strict water conservation measures; as a result, demand was reduced and needs were met

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15. See The President's Intergovernmental Task Force, Urban Water Systems. In 1978, water rates in the 756 urban systems varied from 26 cents per 1,000 gallons to $1.29 per 1,000 gallons ($38 per year to $188 per year for a family of four), so a doubling in rates for many systems appears reasonable just on the basis of this wide variation in actual practice.

at a total cost of $14.7 million (1977 dollars)--roughly two-thirds the cost of an equivalent solution involving new source development alone. 16/

## Charging New Users for New Supply Costs

In areas facing expanding needs to serve population growth, there are several ways to impose the cost of growth on the incoming users. These include increasing connection or tapping fees, requiring repayable advances from developers, or imposing water supply taxes on real estate sales. In Florida, for instance, water management districts im-ose a transfer tax amounting to 1 percent of the value of the real property sold. Revenues from this tax are earmarked for regional water supply development funds. The cost of developing new sources may be reduced in some instances by using conjunctive groundwater and surface water supplies (dual sources used alternately, according to available storage) or groundwater alone, rather than building costly surface reservoirs.

## Improved Access to Capital

Many of the institutional barriers that can obstruct access to capital at the local level could be overcome by a variety of activities available to states. For instance, seven states have set up water-project bond banks to purchase previously unmarketable local bonds, repackaging them for sale as state bonds at lower interest rates. Some states impose debt limitations or interest rate ceilings on local debt that could be removed if local jurisdictions were to issue revenue bonds and increase water rates to a level sufficient to guarantee revenues. Some states issue state revenue bonds guaranteed with local water supply revenue; others simply guarantee local bonds. States can also offer localities financial management or bond marketing assistance.

## Increased Federal Funding

Whatever needs remained after all other options were fully explored could be met by federal assistance. For systems still facing insurmountable capital restrictions, a federal loan or grant program--perhaps an expansion

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16. See Mark Hoffman, Robert Glickstein, and Stuart Liroff, "Urban Drought in the San Francisco Bay Area: A Study of Institutional and Social Resiliency," in Water Conservation Strategies, American Water Works Association (1980).

of the current EDA, HUD, or FmHA programs--could be effective. Alternatively, the Corps of Engineers' water resources development program could be expanded to include construction of single-purpose water supplies with cost-sharing provisions designed to let local jurisdictions repay capital costs (with interest) over a period of perhaps 50 years. If half the shortfalls (see Table VIII-1) were met by applying state and local strategies and half were met with increased federal spending under one or more of these programs, federal outlays for municipal water supply would increase by roughly 56 percent from about $900 million a year to about $1.4 billion. Alternatively, increasing federal spending by the ratio of current federal to nonfederal spending--about 1:11--would result in a $1 billion federal program for municipal water supply.